THE MODEL ENGINEER

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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

At the Fifth Northern Models Exhibition at Manchester, one of the attractions was the Grand Prix Racing Track, which had been built and was presented by the Southport Model and Engineering Club. The photograph, which was taken by our correspondent "Northerner," shows the three cars accelerating away from the starting point.

The track was first shown by the club at their exhibition in October, 1952, and is believed to be the first of its kind to be exhibited in the North. Several sessions a day were staged at the Manchester show, and were greatly appreciated by the crowd.

Of figure of eight shape, the track is not truly realistic, but it has the advantages of being compact, and of giving all three cars the same "lap mileage," which is approximately 50 ft. per lap. Mechanical lap-counters are fitted, and, be it said, are necessary, because one soon loses count when three cars are hurtling round!

SMOKE RINGS

The Reading Exhibition

WE WOULD remind readers that the exhibition organised by the Reading S.M.E.E. is open until Saturday of this week. It is at the Palmer Hall, West Street, Reading. There is a very comprehensive display, and there is also a "bargain counter" at which some attractive and useful items are being disposed of. We note with satisfaction that the society continues to gain strength each year, judging by the quality and attractiveness of its annual exhibition.

One Result of Wanton Damage

ALL SHOULDER lights in the 1,800 non-corridor third class carriages of British Railways (London Midland Region) are to be removed because of wanton damage. "In one four-weekly period," says the London Midland, "no less than 1,700 were torn down and damage totalling £1,200 was sustained." "But," it is added, "apart from the unnecessary trouble and expense of replacement there is the discomfort of passengers who, because of useless lights, may find difficulty in reading. As the shoulder lights are withdrawn, therefore, we shall increase the roof lighting to give adequate illumination."

This is a poor commentary upon the behaviour of certain types of railway passengers. We will wager that they were not model engineers, or they would know how to employ their energies and mischievous fingers to far better purpose!

M.E.T.A. Dinner

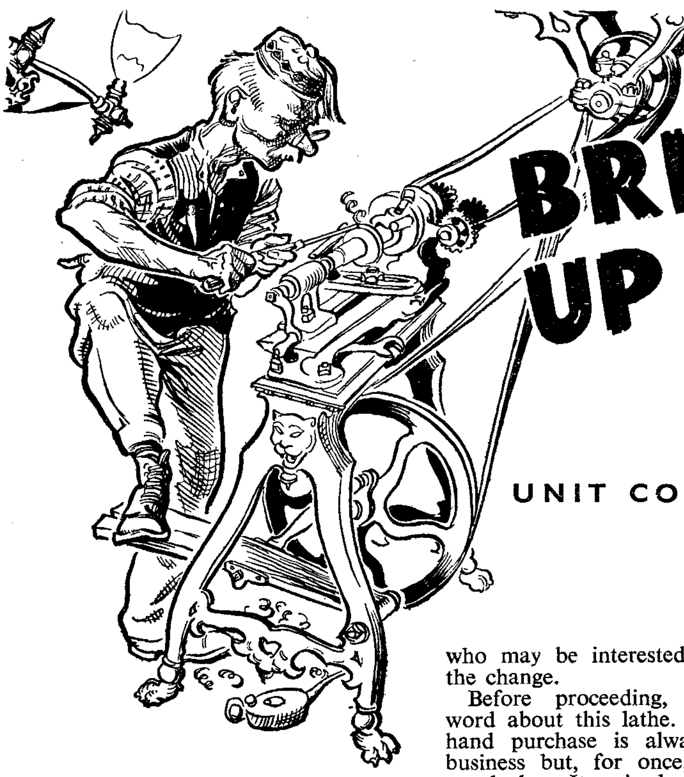
ON APRIL 29th, The Model Engineering Trade Association held its eighth annual dinner and dance at the Charing Cross Hotel. The president of the Association, Mr. George Dow, was in the chair. After the Loyal Toast, a telegram conveying loyal and respectful greetings to H.M. The Queen on the occasion of her Coronation Year, was sent on behalf of the assembled company. The following reply was later received from Windsor Castle: "The Queen sincerely thanks the President, Chairman and Members of the Model Engineering Trade Association, dining together this evening, for their loyal and respectful greetings which Her Majesty greatly appreciates."

The main toast of the evening was proposed by Mr. J. H. Guarnori, president of the Wimbledon Model Railway Club, and was responded to by Mr. Dow. The health of the guests and ladies was proposed by Mr. R. J. Raymond, chairman of the M.E.T.A., and to this the response was by Mr. F. D. M. Harding, general manager of the Pullman Car Co. Ltd.

The Ealing Exhibition

THE EXHIBITION of arts, crafts and model engineering organised by the Ealing Borough Council, and held at the Town Hall during the week April 18th to 26th, proved that there is plenty of excellent craftsmanship to be found in that borough It was conveniently laid out in the main hall and two large adjoining rooms, and this will give some idea of the size and scope of the exhibition.

The model engineering section occupied a room to itself, and consisted of upwards of sixty first-class exhibits, many of them the work of members of the Acton Model Engineering Society, most of whom are residents of the Borough of Ealing. The variety was admirable, ranging from a fine 1½-in. scale Burrell s.c. compound road locomotive, in course of construction, to a neat little replica of the Kon-Tiki raft. The latter was of special interest, as it was the work of 16-year-old Miss D. Kimber, who not only possesses a keen observation but also a talent for clever handiwork. Locomotives, model railways, ships, power boats, aircraft, cars, horology and scenic models were all represented in a well-balanced display. This section of the exhibition was opened by Mr. J. N. Maskelyne.



BRINGING IT UP TO DATE

UNIT COUNTERSHAFT FOR AN M.L.4

By Terry Aspin

ANYONE who has had the experience of using a Myford M.L.7 lathe will probably agree with me that one of its most convenient features is the built-on countershaft. In particular, I refer to the manner in which the drive can be engaged or disengaged at the flick of a lever ; a boon when it comes to screwcutting and many of the " stop-start : stop-start " kind of jobs frequently undertaken by the average amateur engineer. The process may be a little hard on the V-belts (although my own has shown, to date, no ill-effects whatever after four or five years' use) but it *is* a decided factor in prolonging the life of the more costly motor.

Thus, when I acquired, some little time ago, a second-hand M.L.4, I lost little time in fitting it up for power in a similar manner. I offer no excuses for the counterfeit ; the design is excellent and could hardly be bettered and, anyhow, Mr. Myford supplied the lathe ; he may as well supply the idea for driving it ! It is, of course, equally applicable for powering almost any type of lathe of similar capacity. There may be many still using the older system of line-shafting, or even treadle power, who may be interested in making the change.

Before proceeding, perhaps a word about this lathe. A second-hand purchase is always a risky business but, for once, I think I was lucky. It arrived accompanied by much of the usual equipment, including change-wheels, a couple of chucks, a new spare leadscrew and nut and quite a dozen pounds of H.S. tool bits in useful sizes (mostly unused). Summary investigation uncovered but little damage and no appreciable wear, although the condition of the toolpost clamp-nut suggested that the former operator may have had an ambition to become a pipe-fitter. He appeared to have made use of an 18 in. Stillson wrench to the exclusion of all others.

For the remainder, the condition might accurately have been described as neglected and dirty, but certainly not *used.*

Cleaning and degreasing was the initial requirement and this operation was necessarily in the order of drastic. A large container of boiling water was procured and a stiff solution of detergent prepared, with a couple of handfuls of washing soda added for good measure. Into this the stripped lathe was immersed ; one end at a time ; and scrubbed. The bath was strong enough to remove, not only the dirt and grease, but largely the paint as well, so that I had the casting emerging in much the same condition as it left the machine-shop originally. Even the bright iron of the bed responded to this treatment and dried off looking smoothly grey.

All the parts were given the same attention. Smaller items, being allowed to soak, came out even cleaner, so that the repainting, which followed, was carried out as if on new material.

I cannot claim to be an authority on painting of any kind. Having the equipment necessary I am biased in favour of cellulose spraying, which comes very easily to hand. Naturally enough, then, the repainting was carried out in that way. Cellulose filler was applied first and the final coat, which *might* be described as having an " eggshell " finish, was a mixture of the same grey filler and one or two " heels " of glossy cellulose from other jobs. This combined to produce a not unpleasant, light blue-grey, which (I thought) was admirable for the purpose.

By contrast, my new M.L.7 appears to have been painted with a thick, grey, treacly substance, remaining tacky even to this day. It greedily harbours all grime ; any attempt at removing same resulting in the grey stuff adhering to the rag, and defies all efforts in the direction of cleanliness we like to associate with good engineering. Even the smart little Newman motor arrived similarly besmeared " to match " and only now is its own brand of hard, grey enamel beginning to show through.

To this the cellulose finish is infinitely superior, remaining clean and responding to the merest wipe

over. It still looks just as immaculate at time of writing—a year after it was applied.

Patterns and Castings

Photograph No. 1 is the group of patterns. Four of them were made especially for the job. The exception is the 6 in. spoked pulley originally produced for the hacksaw machine illustrated in my earlier article on iron founding. Patterns have a habit of "coming in useful" like this. The rim is wide enough to permit it to be machined to take up to "A" section belt if required.

The design of the unit is for bench mounting and in this capacity it was originally employed. Subsequently, exacting demands on workshop space made necessary its re-adaptation. Fig. 1, a wash drawing (which may, perhaps, tell a better story), in the absence of any photograph from this angle, shows how the countershaft is mounted directly to the rear of an angle-iron stand. The same castings are employed, with two additions at the base, and it will be seen how the whole unit is carried on the $\frac{5}{8}$ in. trunnion *A*. This is a most suitable arrangement where space is limited and the lathe stands back to the wall.

I have previously referred to the use of "packing case" timber for making patterns. None of us would willingly resort to such were a supply of new timber readily available and, thankfully, the position is now becoming more relieved day by day. The examples shown, however, were all produced from such a source and, in the main, were cut from the sides and ends (according to the thickness required) of cooking fat boxes. Any small baker would be willing to oblige, I am sure, but, to those who would seek the favour, I recommend, for the sake of goodwill, approach the man from whom you obtain your regular edible supplies.

Plywood is, of course, unsuitable, though it may, perhaps, be used for specifically "one off" patterns. The main objection to its use is the liability of the laminations to separate when subject to any degree of dampness.

For simplicity, only one pattern is used for the main brackets. As far as I can see, there is no objection to this beyond, possibly, that of appearance. In the assembled appliance, however, this is by no means an obvious feature. The built-up design was determined through limitations of casting and machining. No doubt the arrangement could have been simplified by employing a single casting for brackets and motor mount. Even so, the capacity of a No. 5 crucible was taxed to the hilt, to pour each of the three components separately, and a larger moulding box than already available had to be prepared specially for the job.

This pattern was built-up box fashion and radiused at the angles with plastic wood. The section is quite heavy and produces aluminium castings of ample strength. The angle at which it is constructed brings the centre of gravity of the motor sufficiently forward to balance the whole unit even when it is not fastened down.

The pattern for the motor mount was laminated and some saving in metal was effected by recessing the underside, though this does limit its application with regard to the type of motor to be employed. The thickness allows of subsequently machining the casting both sides.

Perhaps the most interesting shape

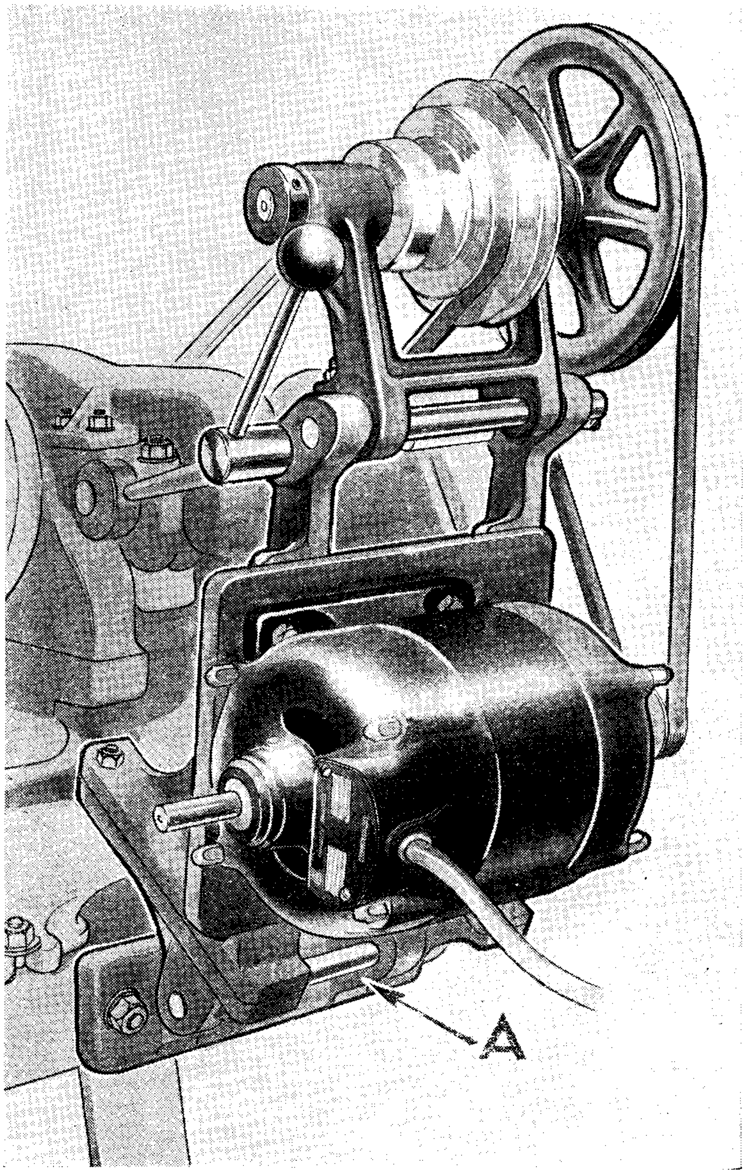
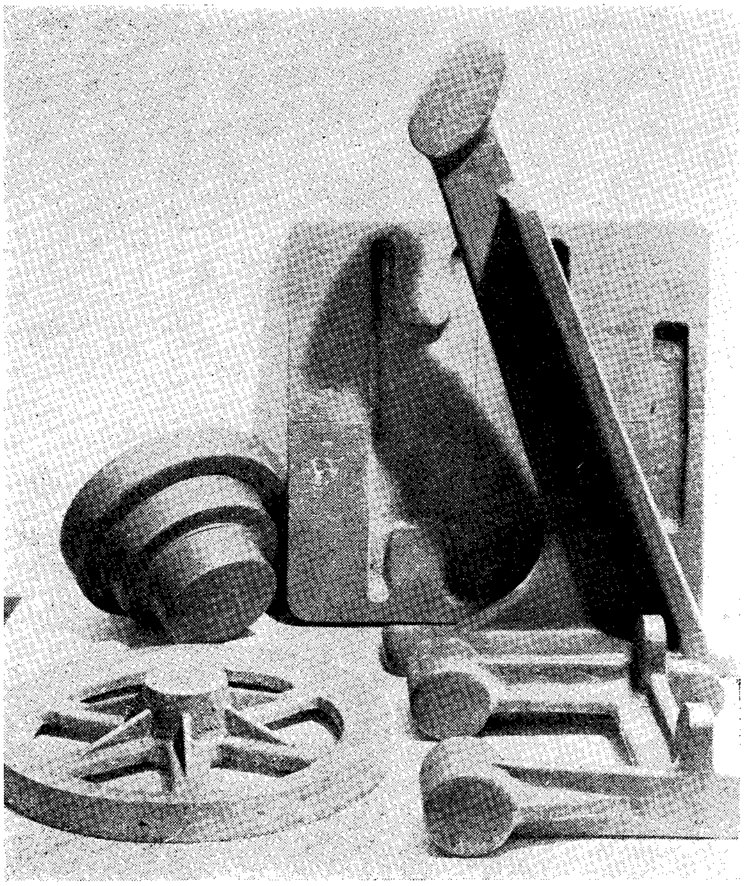


Fig. 1. Mounted on an angle-iron stand



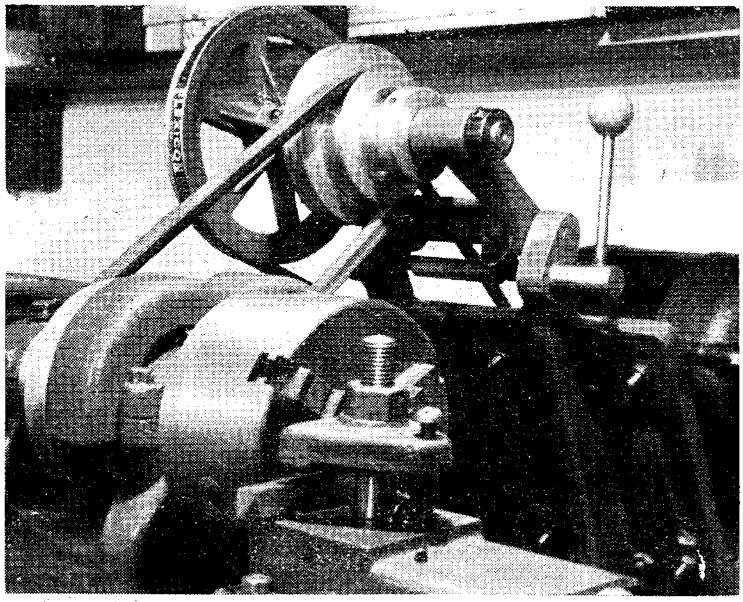
The patterns

to construct was the pattern for the countershaft bearing arms. This was also built up from no less than six main pieces of wood, with the thickness increased by further pieces added where extra metal would be required. These were the trunnion bearings and pads for the adjusting screws. Fig. 2 gives a general idea of the method adopted, plastic wood again being used to form the radii.

Such a shape is easy enough to mould by ordinary methods, the simplest side being laid downwards and, after ramming and inverting the drag, the surplus sand is removed from the exposed part of the pattern down to the inside web, and a neat dividing line, designed to leave as little as possible to be drawn from the cope, fettled in with the trowel. Fig. 3 shows how such a pattern would appear embedded in the drag, before the upper part of the mould is rammed. The runner stick is in position and the dotted lines indicate where the ingates will be cut. *A*, *B* and *C* are little fillets of sand put there to facilitate the subsequent removal of the cope. They will not be disturbed when the pattern is finally rapped out.

The clean withdrawal and separation of moulds with an intricate parting line, or indeed of any mould, is greatly assisted by the use of a good quality parting powder. In this connection I recommend interested readers to get in touch with Messrs. Foundry Services Ltd., of Long Acre, Nechells, Birmingham. Their name has been mentioned by other contributors to this journal in the past and they will readily render assistance to anyone with a genuine interest in foundry work, even to supplying small quantities of their products, fluxes, etc., with which the melting of all metals, iron, aluminium or cuprous, is greatly facilitated. I have been making use of their materials from my earliest efforts.

The main piece of wood for the 6 in. pulley was a disc $6\frac{1}{4}$ in. diameter by $\frac{5}{8}$ in. thick. For turning, it was transfixed with a headless $\frac{1}{4}$ in. bolt, nutted either side, by which it was held in the three-jaw chuck. In this way it was given a draught angle at the rim and the centre section turned to the required thickness for the spokes. The method of chucking makes reversal a simple matter when dealing with the other side of the disc



In use on the bench

and, when sanding wooden patterns of this kind, rather than risk fouling the lathe with grit and dust, I chuck them in the portable electric drill and perform the abrasion where it will do no harm. (Funny how we go to no end of trouble to protect our tools, but give little thought to what the condition of our lungs will be when we have finished !)

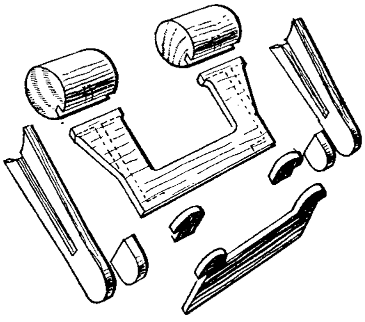


Fig. 2. Showing the construction of the bearing-arm pattern

The spokes were cut out on the jig-saw and the boss added afterwards with glue and a dowel through the centre. The webs are small triangles of wood glued in place, and later, made quite firm by the application of the eternal plastic wood to form fillets. The point has been made elsewhere that, having gone to a fair amount of trouble to produce such a pattern, it is well worth making one extra casting of it in light alloy to act as a standby should the original become warped or damaged.

Three separate discs formed the step pulley with a ½ in. bolt passed through them to hold them together. The idea had not occurred to me at the time, but I now feel that it would be handy to have a number of such plain discs, each with the required draught angle and a centre hole for bolting together. Patterns for pulleys, backplates and so on could then be assembled as required by varying the numbers and diameters as the case may be. Fig. 4 illustrates the inspiration.

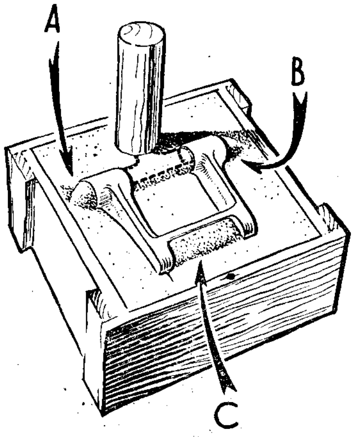


Fig. 3. Moulding sets many problems

The step-pulley casting was, of course, required in duplicate, one for the countershaft and the other to replace the original flat belt pulley on the lathe mandrel. When casting heavy sections like this in aluminium, as large a runner as possible is needed to ensure the minimum of shrinkage. A direct pour through the centre of the mould can sometimes be adopted to advantage, especially if extra care is taken in skimming the metal to avoid inclusions.

A few observations on the melting of aluminium alloys may not be out of place. A crucible is better than an iron pan. Many metals are soluble in molten aluminium, iron more than most, and such impurities are detrimental. In its molten state it oxidises very readily and also before this stage is reached. For that reason it is well to bring the pot to red heat before charging the scrap and to melt as quickly as possible without overheating—another source of mischief. Have your mould ready before commencing the melt so that there will be no risk of having to " stew " it while, perhaps, a damaged mould is repaired or another prepared. The " many a slip " proverb applies very strongly here !

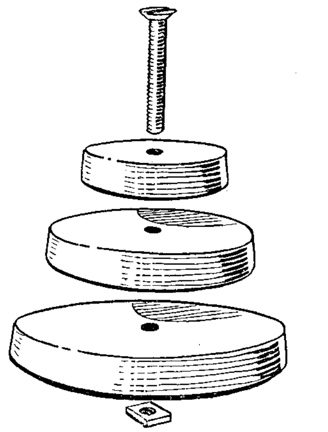


Fig. 4. A way out of the pattern difficulty. Each disc should be painted separately, and expendable lengths of wooden dowel could be substituted for the screw

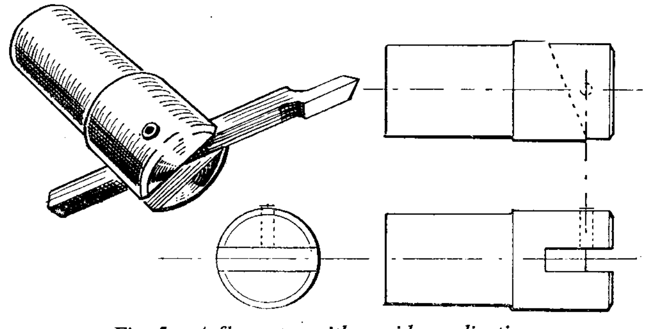


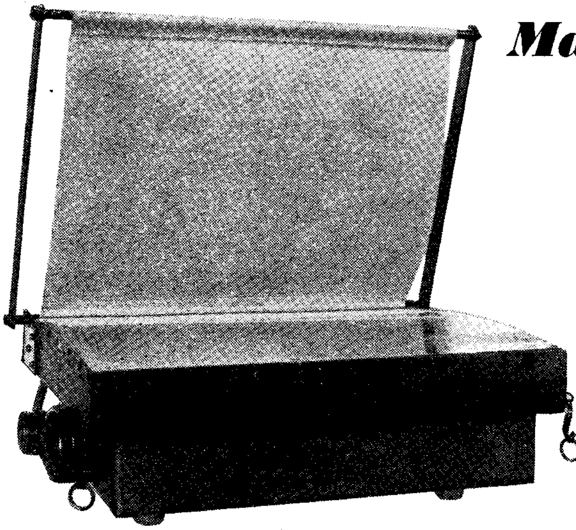
Fig. 5. A fly-cutter with a wide application

Machining and Assembly

Perhaps one of the most marked advantages in the use of light alloy, where applicable, for machine parts is the ease with which it can be worked with cutting tools. (Filing, of course, is a different story !) In this case, machining the components was really very simple. The motor mounting-plate was a job for the 6 in. independent chuck when, mounted thus, it cleared the lathe bed with about a thou. to spare. Although a plate of ample dimensions is required, there would be no excuse for making it too large to turn over the bed. The thickness not being critical, it was simply skimmed clean both sides.

The two main brackets were packed up on the cross-slide for fly-cutting ; the bolting flanges for the motor mount and the feet requiring this attention. Here, again, the work could just be accommodated and only then by the use of an extended cutter. My own fly-cutting equipment allows the use of interchangeable ¼ in. tool-bits and even forged tools if the need arises. I include a sketch of it (Fig. 5) for what it is worth.

(To be concluded)



Making a

PHOTOGRAPHIC PRINT GLAZER

By "Dioptre"

Fig. 1. The finished glazing machine

As glazing prints made on bromide paper tends to increase contrast and bring out the details of the image, this is a matter of some importance where photographs are required for reproduction or for record purposes. Blockmakers prefer prints of not less than ½-plate size, as the finished blocks are, as a rule, smaller than the original print. If it is found convenient to glaze four ½-plate prints at a time, then the glazing plate itself should be made at least 14 in. × 10 in. in order to allow intervals for spacing.

The glazing machine described is heated by standard electric fire elements, and the temperature is controlled by means of an adjustable shutter which allows a cooling current of cold air to flow over the heating coils. Starting from cold, the prints are dried and glazed in approximately 15 min. with a small consumption of current.

Construction

The base portion of the glazer consists of a sheet-metal box without a lid (*A*). This was made from sheet-iron, cut to shape and then hammered over a wooden block to bend up the sides and ends. Next, the lap joints formed at the corners were secured by riveting. The box could be made of hard wood, but the interior must then be lined with asbestos sheet as a protection against heat. The holes for the ceramic feet on which the box stands, and in fact all the remaining holes in the sheet-iron, can be easily drilled in the finished box either in the drilling machine or by using a hand drill.

The Heating Element

The ceramic fittings for supporting the heating wire were taken from a discarded electric fire. These are mounted on ceramic, double insulators and secured to the floor of the box with small bolts. The lower insulator is formed with a register that centres the insulator in the hole drilled in the box ; this ensures that the fixing-bolts are kept well clear of the metal parts. In addition, the bolt heads must be deeply recessed in the lower insulator. Avoid bolting down too tightly, as the element holders are rather fragile. As it is important to heat the glazing plate evenly, the heating elements should be spaced to distribute the heat uniformly.

After the ventilating openings have been cut out in the floor of

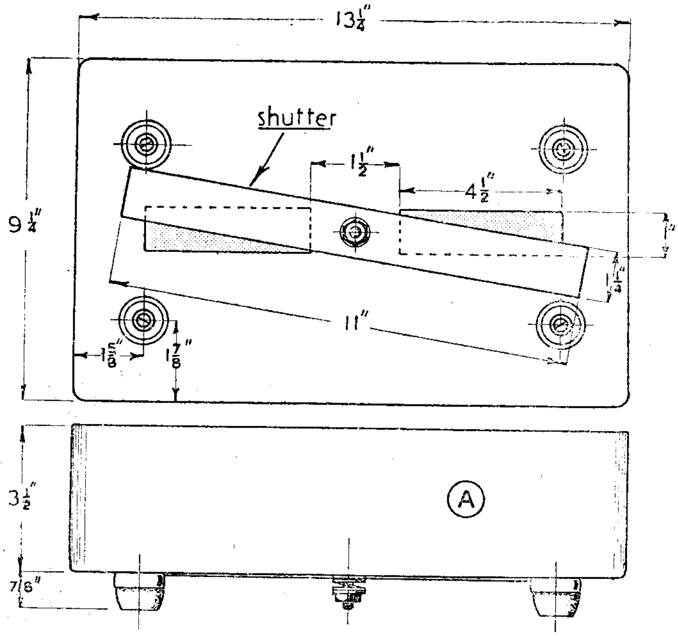


Fig. 2. Showing the sheet-metal box (A) and the method of fitting the shutter

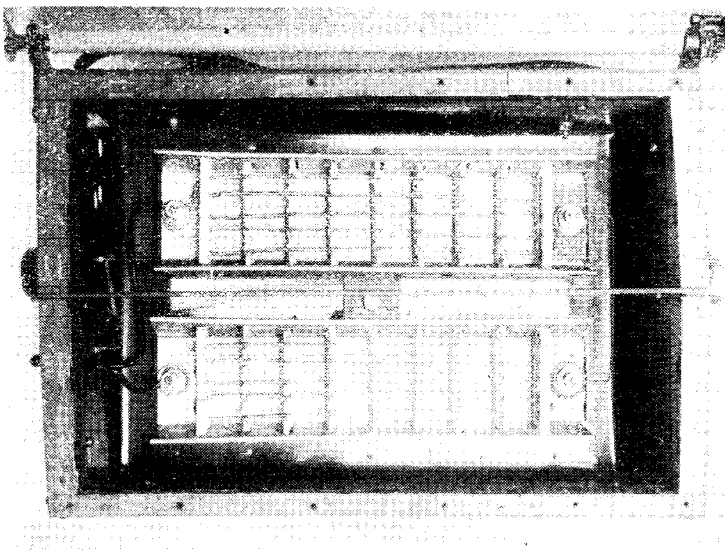


Fig. 4. Showing the heating elements and the wiring within the box

the box, the shutter for controlling the temperature is fitted as shown in Fig. 2. These openings should be spaced to ensure, as far as possible, that the heating wires are cooled uniformly throughout their length. When doing any drilling or cutting work on the box, the ceramic wire holders should, of course, be removed to save them from damage.

A Safe Temperature

The temperature of the glazing plate need be no higher than is necessary to dry the prints in a reasonable time; this is safer for the prints and also keeps down the current consumption.

With the ventilating shutter closed, the heating wires may attain a low red-heat, but on opening the shutter the temperature will fall and the wires may then become no more than black-hot.

To increase the electrical resistance and limit the current, the elements are wired in series, and it was found that sufficient heat was produced by wiring four 200 W heating coils end to end.

The electrical resistance rises, of course, as the wires heat up, but when working at a comparatively low temperature, this arrangement will have a low current consumption and should last almost indefinitely. The d.c. resistance of the system was found to be 400 ohms when cold, so that the current passing at the normal mains voltage should not exceed some $\frac{1}{2}$ ampere after the wires have become hot.

The Wiring

The general arrangement of the wiring is shown in Figs. 3 and 4. All live points must be properly insulated to give full protection when handling the machine.

Any connecting wires should be well supported and, where necessary, protected with ceramic beads, for it is important that, in the event of breakage, the wiring should not make contact with the metal box. One of the elements is connected to a single-pole switch attached to the end of the box, and a lead is taken from the other element to a three-pin plug connector.

Where the wires pass out, large holes are drilled in the sheet-metal casing and ceramic grummets are fitted to protect the wiring.

Earthing

As a matter of ordinary safety, it is essential to provide an effective earthing connection by attaching the third or earthing wire of the supply cable to the metal box. On no account, should the supply cable be connected to the switch by means of a removable plug, but this arrangement can be made safe by securing the plug in place so that it cannot be withdrawn without dismantling the machine. Where the glazer is connected to a lighting circuit the ordinary line fuse will serve, but if a power circuit is used for the supply, it is advisable to fit a separate fuse-box and fuse of lower rating inside the casing.

This finishes the heating components, and it now remains to make the parts required for mounting the glazing sheet and holding the prints in place.

The Wooden Frame (*B*).

The wooden frame, carrying the glazing plate, is secured with wood screws to the sides of the metal box, and a lining of asbestos card is used to protect the woodwork from heat. Some workers prefer to squeegee the prints on to the glazing plate after it has been removed from the machine; in this event, the frame should be made easily detachable. Again, some like a flat plate rather than the curved glazing plate shown.

A curvature rising $\frac{1}{4}$ in. in the 10 in. run of the frame will be found suitable. Ventilation holes are drilled in the end and side members of the

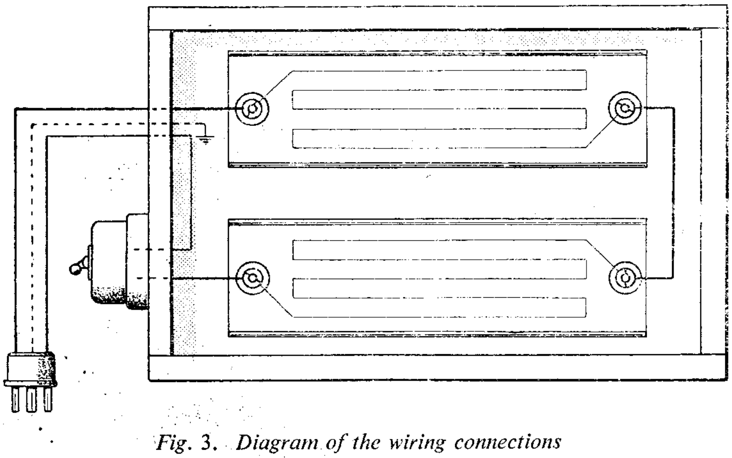


Fig. 3. Diagram of the wiring connections

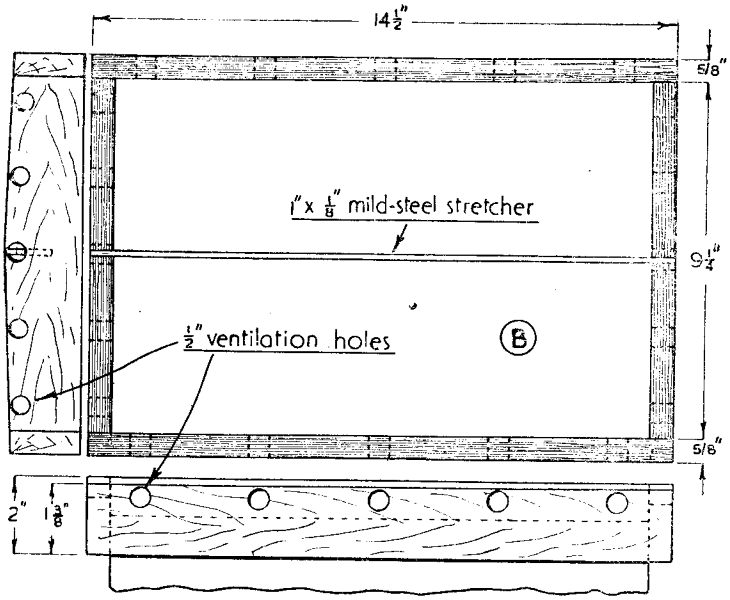


Fig. 5. The wooden frame (B) and the stretcher

frame to allow the currents of hot air to pass freely over the under side of the plate, and so maintain an even temperature throughout. A stretcher, running lengthwise in the frame, is necessary to prevent the glazing plate being buckled inwards under the pressure of the squeegee ; this is made from a strip of ⅛-in. × 1-in. mild-steel, placed on edge.

The glazing plate is next cut to shape, and the holes for the fixing-screws at the top and bottom edges are drilled and countersunk. The best plates are made of chromium-plated brass sheet, but the cheaper, plastic plates are also used, although they are more easily scratched and have then to be replaced.

After the upper edges of the frame have been covered with strips of asbestos card, the plate is carefully screwed down so that it bears evenly on both ends of the frame.

The Apron (*C*)

An apron is fitted for holding the prints in close contact with the glazing plate until quite dry. If the prints are allowed to curl at the edges, while the centre still adheres to the plate, not only will the glazing be patchy, but cracks will appear in the gelatine coating in the form of the so-called " oyster-shell " marks. Thin, pliable canvas has been found the best material for making the apron, and the back and front edges are sewn to form tunnels for the passage of the rods or tubes forming the apron frame. This work can be put out for stitching in a sewing machine ; but, as a change of occupation, a neat job can be made in the workshop by hand-sewing.

The frame is built up of rod, tube, and flat material to the dimensions given in Fig. 7. It is important that the finished frame should be flat and square so that the canvas apron can lie flat and maintain even pressure on the glazing plate.

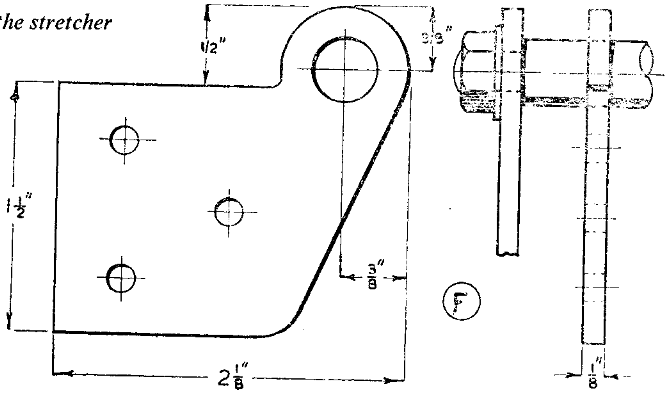


Fig. 8. The left-hand hinge bracket (F) with details of the hinge

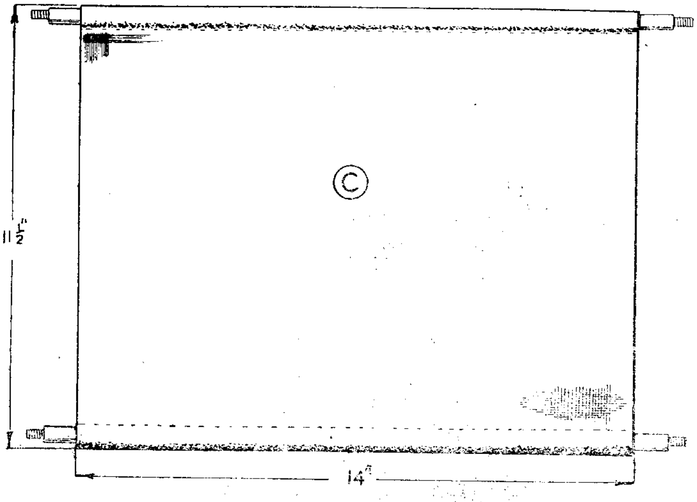


Fig. 6. The canvas apron (C) with its back and front frame-rods

The Hinge Brackets (*F*) **and** (*G*)

A bracket is attached to either

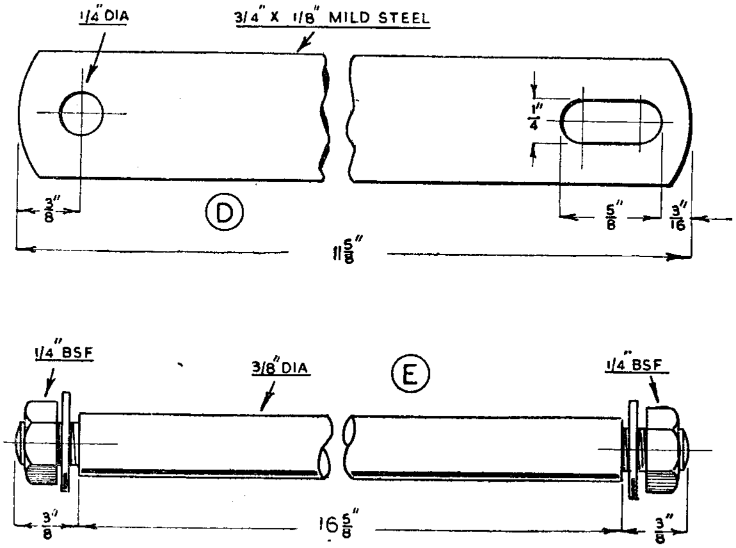


Fig. 7. D—the side members of the apron frame ; E—the back and front frame tubes and rods

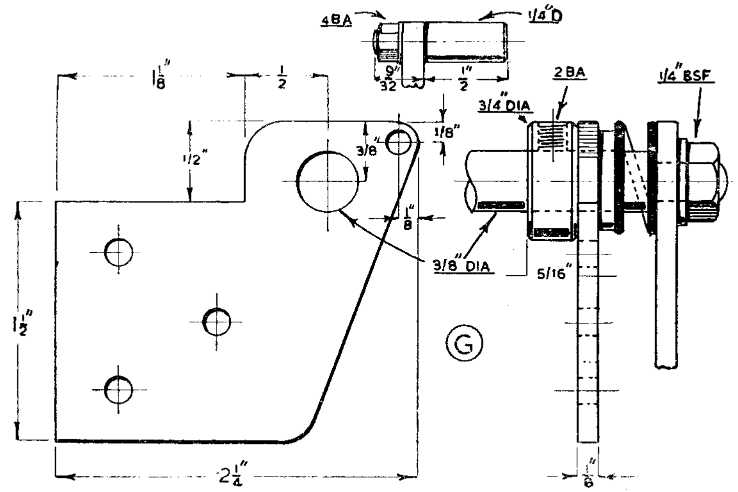


Fig. 9. Showing the right-hand hinge bracket ; also, details of the frame-stop and friction joint

end of the wooden frame to carry the rod supporting the back edge of the apron. The dimensions of the left-hand bracket are given in Fig. 8, and the fitting of a distance collar to the apron rod is also shown. The right-hand bracket, Fig. 9, is fitted with a stop-arm to limit the backward travel of the apron frame to a point just beyond the vertical position. The pressure on the double-coil, spring washer is adjusted to keep the frame from falling by its own weight. Pressure is maintained on the prints while drying by fitting a spring and latch (Fig. 10) at either end of the wooden frame to keep the apron evenly stretched.

The Glazing Machine in Use

After the prints have been fixed, hardened, and washed, the gelatine surface should be carefully wiped to remove any adhering particles left by the tap water.

Sprinkle the glazing plate with water, and then roll the wet prints on to the plate so as to make even contact and expel any air. Squeegee the prints firmly down and remove any excess of water with a sheet of blotting paper or a clean towel.

Experience Pays

The glazer is now switched on and the apron closed. After about 15 minutes, the apron can be lifted and the prints should then rise clear of the plate; if not, close the apron and try again after a short interval. The next batch of prints can be put on even if the plate has not cooled, but one must work quickly or the prints will dry at the edges and patchy glazing will result.

The best technique to adopt will be found by experience, for some workers when following the ordinary routine fail to get good results, and others get perfect glazing without seeming to pay any particular attention to details.

The nature of the tap water is, perhaps, sometimes to blame, and the use of a glazing fluid may provide a remedy.

Printing Papers

Air held in solution in the water is expelled on heating and may then raise the prints from the plate in places and give patchy glazing. The various brands of printing paper also vary in their capacity to take a good glaze. Thin paper is usually easier to deal with than the double-weight variety. Some advise squeegeeing the prints very heavily, and others insist that only light pressure should be used. Whether to apply the prints to the cold glazing plate or only after it has been heated, is another point on which opinions vary. However, as long as the equipment is suitable and the plate is kept scrupulously clean, a few experiments should result in obtaining consistently good glazing.

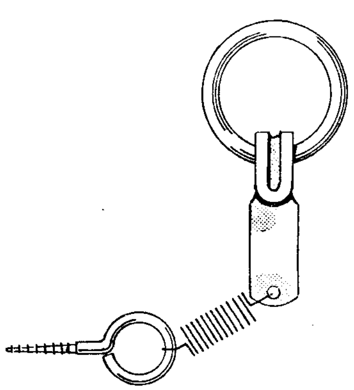
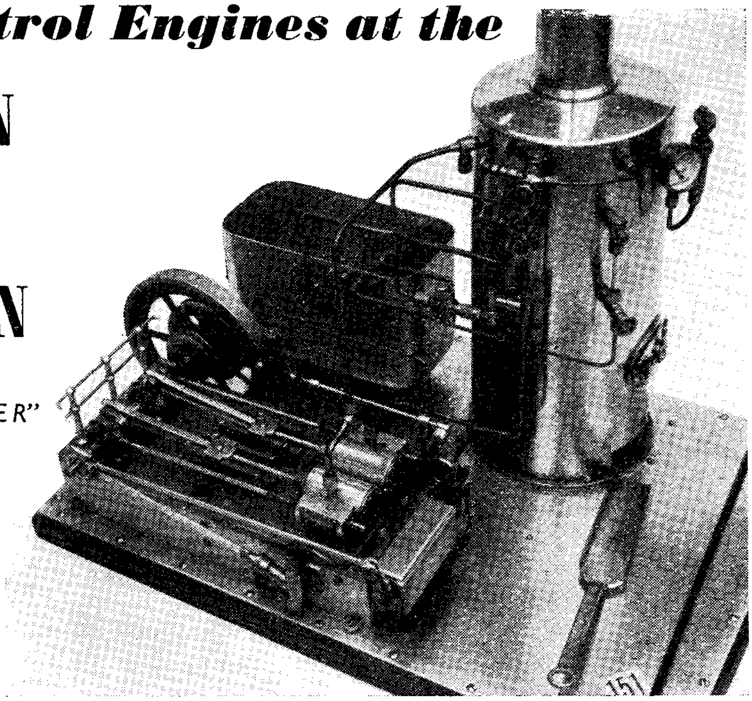


Fig. 10. The spring latches for tensioning the apron

Steam and Petrol Engines at the

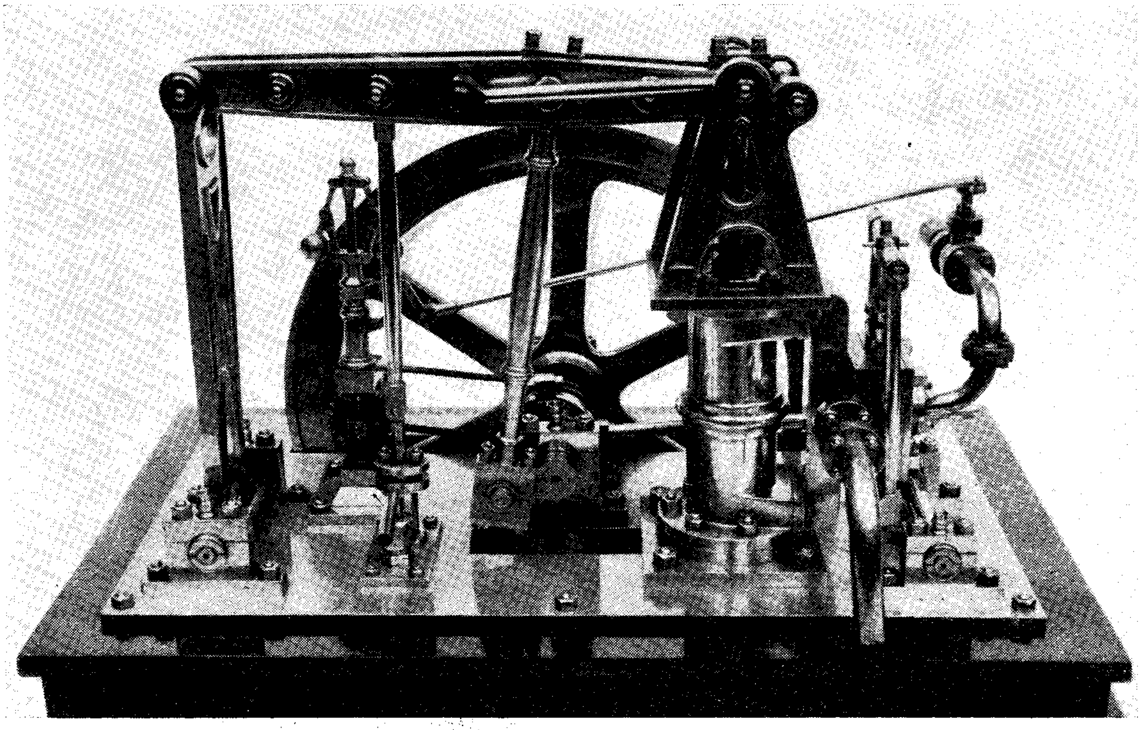
NORTHERN MODELS EXHIBITION

REPORTED BY "NORTHERNER"

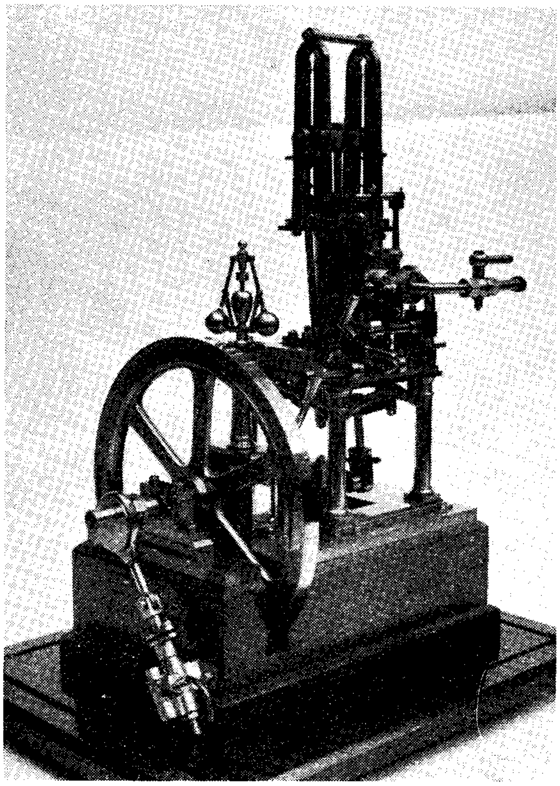


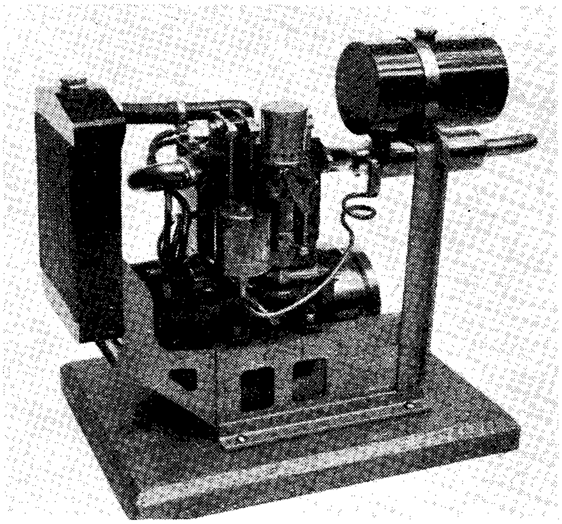
A free-lance two-cylinder stationary engine and boiler by J. B. Clegg, of Leigh

A two-cylinder horizontal engine and boiler, shown in the heading photograph, won the Second Prize in its class. It had obviously entailed many hours of work for its builder, J. B. Clegg, of Leigh, but one could wish that his use of cheese-headed screws had not been so universal—there was scarcely even a hexagon nut in the whole assembly, let alone a hexagon-headed screw. Another undesirable feature was the wide-



This well-proportioned grasshopper engine was built by the late D. E. Haywood





A. Brookes' well-finished two-cylinder ***water-cooled*** *engine*

Left—Another fine engine built by Mr. Haywood

spread use of aluminium or dural.

The model was free-lance, and appeared to be almost wholly fabricated. Marine-type big-ends were fitted to the fluted connecting-rods, and the cross-heads embraced single slide-bars at each side. The eccentric which drove the water-pump also worked a mechanical lubricator which was mounted at the rear of the bedplate.

Impressive Fittings

Coal-fired, the boiler carried an impressive array of screw-down valves and other fittings, including an injector, but it was felt that the network of various pipes could have been made less obtrusive. Finish, on the whole, was good, though more paint and less polish would have been welcome.

Regarding the grasshopper engine and the table engine, I do not intend to say much now, as it is proposed to devote a separate short article to these later, with more photographs. Those given now will help to whet the reader's appetite, I hope.

Petrol Engines

The four-cylinder overhead-camshaft engine has already been described in my preliminary report on the exhibition and illustrated on the cover of the May 14th issue, so its features need not be mentioned again. This was the engine to which the first prize was awarded.

A very neat engine was that which won second prize for A. Brookes, of Warrington. To the well-known "1831" design, it was embellished with a tubular radiator and a silencer, and was mounted on a neat frame, incorporating a standard to support the petrol tank. The finish was good on both the bright metal parts and the painting ; the castings had been well finished *before* painting, which makes a lot of difference to the result !

NEW ABRASIVE MATERIAL

Samples of a new range of abrasive papers and cloths have been submitted to us by Minnesota Mining and Manufacturing Co. Ltd., Arden Road, Adderley Park, Birmingham 8. These are made in the form of both sheets and rolls, and coated with various types of abrasives such as aluminium oxide, silicon carbide, garnet, etc., in a full range of grits from No. 16 to 600. They are manufacturered under scientific conditions to suit the needs of modern industry, with backings to meet the most exacting standards of strengths and flexibility, and bonded by heat-resistant or waterproof adhesives where this is called for. Appropriate backings, bonds or grits for all kinds of hand or machine applications can be supplied, and in the booklet "Step up Production" issued by this company, various industrial applications of the abrasives are illustrated, including disc, drum and contact wheel, and band or belt machines up to 50 in. wide. These materials are obtainable from engineers' supply stores, and in case of any difficulty in obtaining retail supplies, application should be made to the manufacturers at the above address, who we feel sure would be most helpful.

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

SMALL VACUUM BRAKES

DEAR SIR,—In the issue of April 9th last, Bro. Hyphen replies to certain comments which I made in a previous issue about vacuum brakes and other items; and I regret to note that these replies are unconvincing and contradictory. They won't stand analysis; for example, he originally eulogised a vacuum-brake ejector made by a friend, said in effect that it brought nearer his "dream of the future," continuous brakes on small rolling-stock, and says gleefully "Now we *are* getting somewhere!" It is easy enough for anybody to find the road, when someone else has been along and put up the signposts; and our friend now admits that I have already described how to make ejectors, and how to fit up continuous brakes. Incidentally, I also stated that they were an unnecessary complication for little trains of two or three cars, which an efficient hand-brake could stop quite easily; but may I point out that anybody fitting up continuous brakes, might not take the trouble to write and inform Bro. Hyphen about it? Mr. Ford didn't, until our friend's original comments appeared; and then he wrote to the Editor! I might mention that the late "Bro. Wholesale" fitted air brakes to his rolling-stock, but didn't broadcast it.

In the third column on page 452, Bro. Hyphen again admits that the normal type of vacuum brake only needs a simple ball valve for its operation. That being so, why introduce complications? In full-size practice, the ball valve, aided by a rapid-action device supplied by the firms making brake apparatus, does the job satisfactorily. The late Sir. H. N. Gresley devised a special rapid-action valve of his own, for use on the L.N.E.R. ground flying-machines. The purpose of these valves is to admit air direct to the underside of the brake piston on each coach, instead of the whole lot having to come through the train pipe; an advantage, when there may be nearly a thousand feet of pipe between the driver's brake valve and the brake cylinder of the last coach. Air at atmospheric pressure moves through a pipe at the same speed, within reason, irrespective of the size or length of the train; and as the length of the longest train every likely to run on the Beech Hurst line would not exceed the length of a single coach in full size, the simple ball valve would be all that is required.

Vacuum is vacuum, whether created by an ejector, pump, or any other means; therefore Bro. Hyphen's remarks that the special brake he claims to have evolved needs no ejector, are meaningless, because vacuum created by *any* means will operate the ball valve. He also mentions devising a simple form of "triple valve." The simplest form of "triple valve" is an ordinary three-way cock! "A rose by any other name smells just as sweet," says the old saw. Now the Westinghouse triple-valve (the only true "triple-valve," a name given to it by the Westinghouse folk, as it performs three functions, viz., admitting air to the brake cylinder, exhausting it, and recharging the "local" air reservoir) relies on air pressure to keep the slide valve on its seating; there is a small flat spring at the back, to retain it in place when the triple valve is arranged in a vertical position. It would not operate with vacuum; so whatever kind of valve Bro. Hyphen has in mind, it won't be a true triple valve, and it won't be any improvement on the simple ball valve used in full-size practice! If any readers would care to study the matter for themselves, they should purchase the two handbooks, *The Westinghouse Air Brake* and the *Vacuum Automatic Brake*, published by the Locomotive Publishing Co., and they will find ample confirmation of the above statements.

Bro. Hyphen's remarks on brake linkage certainly gave other folk beside myself, the impression that he was claiming to have evolved a "super" system of rodding and connections. I have already described a system requiring neither rodding nor linkage; a combination of the hydraulic brakes on my gasoline buggy, with the Stroudley driving-wheel brake cylinder. There is nothing new under the sun!

Regarding the valve-gear drawing, or rather lack of it, I am afraid that our friend's explanation is again inconsistent, because he has repeatedly asserted that he cannot understand how anybody can get along without drawings; says that he drew out his valve-gear, and the parts, made to drawing, fitted like a jigsaw puzzle—yet he denies the same advantage to anyone building his "Twin"! Pages of explanation will not make up for the lack of a drawing of so vital a part of the engine; and speaking of jigsaw puzzles, they all include a picture with the "key." I don't know how many "Twins" are growing up —they should be quite big girls by this time!—but I would suggest that even now, it is not too late to substantiate his assertion mentioned above, by publishing the general arrangement drawing of the valve-gear *as applied to his own engine*; not a reduced reproduction of the full-sized job. It might save prospective builders from studying my valve-gear drawings, to try to get the necessary information!

Yours faithfully,

Purley Oaks. "L.B.S.C."

FLUORESCENT LIGHTING

DEAR SIR,—I note with some surprise that in Mr. Clawson's letter on the above subject, he goes to some length to prove that the twin-tube circuit that accompanied my letter is wrong.

Perhaps I should have stressed the fact that the circuit was not of my own design, but taken from the prevailing circuits in common practice for this type of lighting today. To prove this point, I would like to quote from Philips' latest Light Fittings Catalogue as follows:

> "To form a high power factor twin lamp circuit reducing stroboscopic effect for 80 W, 5 ft. and 40 W, 4 ft. lamps, two single lamp low power factor ballasts may be used with a 440 V series capacitor."

Mr. Clawson's arrangement, using one choke, would not work in practice, however much it appeals to him in theory.

One choke may be used for two 40 W, 2 ft. or two 20 W, 2 ft. tubes in *series*, but the chokes will be 80 W and 40 W respectively, and the P.F. condensers to match will be across the supply mains. The effect

of this arrangement is the same as for a single tube.

Stroboscopic effect is a distinctly annoying and disconcerting thing that could lead to accidents. The direction of rotation often appears reversed and the speed of a revolving object is almost impossible to judge. All this may not seem dangerous, but for that matter, why put a guard round a countershaft ? No-one would purposely put their fingers into a revolving pulley.

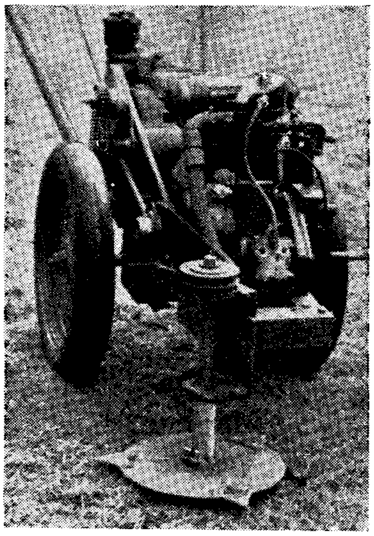
The fact is, this effect is a potential danger and manufacturers have produced the necessary equipment and circuit to remove something which they obviously do not treat so lightly as Mr. Clawson.

Yours faithfully,
Erith. H. F. PANKHURST.

A HOME-MADE MOTOR CULTIVATOR

DEAR SIR,—The photographs herewith of a garden cultivator show the machine equipped with rotary grass cutter and air compressor. Other attachments not shown include a 24-volt, 1,000-watt generator which supplies current to a hedge trimmer, a 1,000 g.p.h. rotary pump and a twin-cylinder air compressor with tank. Garden cultivating tools can be bolted to the rear of the machine and comprise plough, cultivating points, hoes, etc. A circular saw bench is under construction.

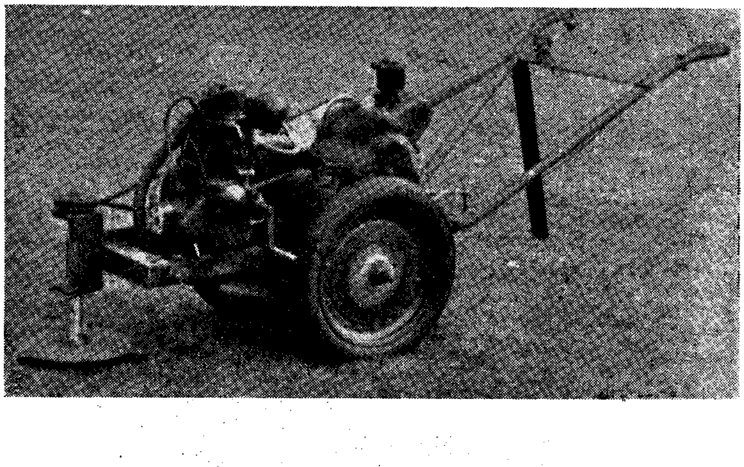
The engine is a 1¼-2 h.p. Alco Lyon four-stroke engine (Govt. surplus) which is connected by V-belt to a lorry gearbox giving four speeds. With engine turning at 1,500 r.p.m. the machine runs at ½ m.p.h. in bottom gear and 4 m.p.h. in top gear. Power can be applied to either wheel or both by means of dog clutches. Steel wheels (cleated) are substituted for work on the soil. The machine weighs about 2 cwt. and is very powerful. All parts, except pneumatic tyred wheels and engine, are from scrap dumps at



a cost of under £1 (including air compressor).

I would mention that a machine of this size would have cost me about £100 to purchase. Rotary pump generator and air compressor, another £100, as against under £5.

Yours faithfully,
Hawarden. A. HAYES.



FIRELESS SMOKE?

DEAR SIR,—As I did a considerable amount of proof reading when I was engaged on technical writing, it has become almost a sixth sense to spot errors in type-setting and, as I read THE MODEL ENGINEER almost from cover to cover, not a few are found therein. Usually, they are of a trivial nature and not worth a second thought. Occasionally they are glaringly obvious and therefore not worthy of comment, as recently, when *Britannia* came to grips with the *Canterbury Lamb*.

Sometimes an error slips by which produces noteworthy unintended humour. Such a one is the reason for this letter, for I see the gremlins have been at *Britannia* again, page 380, col. 3, line 33 & ff. Sometimes I think it would be a good thing if the House did disappear in a cloud of fireless smoke !

I will conclude by saying how much I enjoy reading THE MODEL ENGINEER every week especially "L.B.S.C.'s" tonic. Furthermore, THE MODEL ENGINEER has often been of real use to me in my present occupation of draughtsman and technical illustrator.

Although fault-finding has become a second nature to me, I am not a fault-finder by first nature.

Yours faithfully,
Salisbury, A. C. V. KENDALL.

ELECTRONIC ORGANS

DEAR SIR,—I recently commenced construction of a Hammond type polyphonic electro-magnetic organ, working on the ideas and designs of Mr. C. C. Clarke, whose magnificent instrument was shown at the last "M.E." Exhibition.

My poor locomotive, a two-thirds finished 0-4-0, 5-in. gauge *Ajax* is now sulking in the corner of my workshop, covered in oil and dust, while my M.L.7 is degraded to perform such jobs as coil-winding and tone-wheel profiling.

My long-suffering wife now finds herself being dragged into the workshop to listen to heart-rending howls issuing from the amplifier, and to observe the latest wave-form on the oscilloscope.

My main reason for writing this letter is to recommend this project as a fit subject for model engineers, because, apart from the amplifier, *it is not electronic* but electro-magnetic. The tone generators which are the heart (and soul, although many organists would dispute that electronic organs have such things) of the instrument, are entirely a job for the mechanical engineer, and call for quite a high degree of care and accurate machining. The key contacts and wiring, etc., are pretty complex, but quite simple in principle. There is a vast multi-tapped transformer with something like 30,000 turns on the secondary, but if this physical endurance test involved in winding can be survived, I do not think it should be particularly difficult (famous last words).

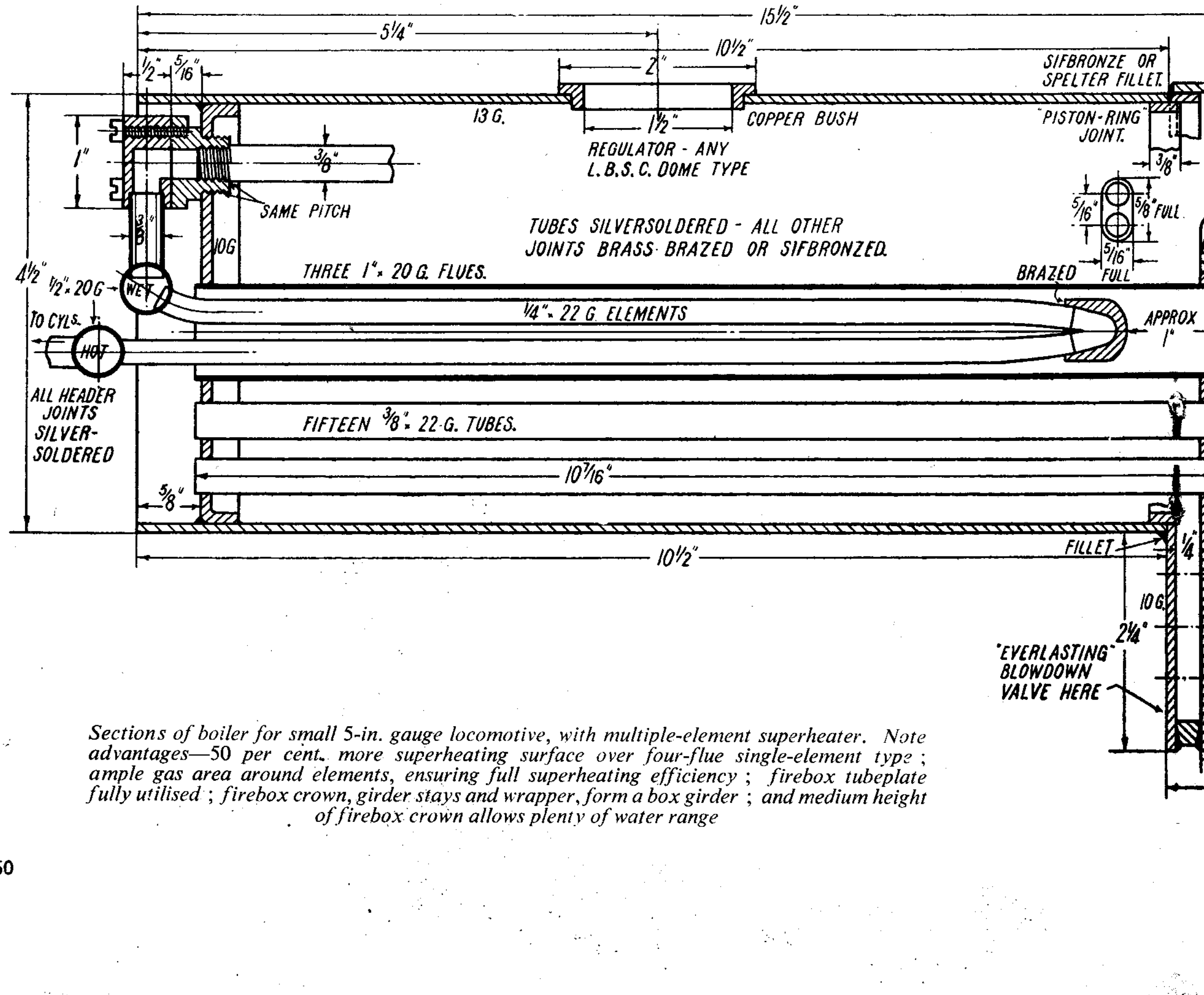
If any reader in my locality is interested or working on a like project, I should certainly be interested in hearing from him or (is it possible ?) her.

Yours faithfully,
Morden. JOHN N. W. PAYNE.

L.B.S.C.'s Lobby Chat

● MULTIPLE-ELEMENT SUPERHEATERS

SINCE the *Maisie* book was published, containing details of an improved multiple-element type of superheater, in place of that described in the serial story, inquiries have come to hand regarding its application to other types of locomotives. We might therefore use this subject as a peg on which to hang a lobby chat. As our locomotive-building readers know full well, one item contributing to the success of the engines described in these notes, is an amply supply of *really hot* steam, which makes them as lively as the proverbial kitten, keeps the coal and water consumption down, and entirely does away with cylinder condensation. The single-element superheater described for the smaller engines, such as *Tich* and *Invicta*, and those with three or four flues, each with a single element, connected at the ends by headers made from tube, have all done the job; but there are cases where it might be advantageous to go a step nearer to full-size practice, and put two elements in one flue. In the early part of the war, I made a new boiler for a 2½-in. gauge 2-8-2, the original boiler of which was an absolute and complete failure. She was commercially made, and belonged to a friend; I gave him one of my own engines in exchange for her, and like Sophie Tuckshop of the radio, she's all right now. On setting out the tube arrangement for the new boiler, I found that by using one large flue with the two elements in it, instead of their being housed separately, it was possible to get a much better arrangement of the small tubes. The boiler was built thus, and came fully up to expectation; bags of "redhot" steam, and no "bird's-nesting," as the enginemen call it, when ashes or cinders lodge against the ends of the elements and block up the flue. That was the reason for the amended design of boiler and superheater for *Maisie*. I am using a similar arrangement on my own experimental job, of which more anon, all being well.



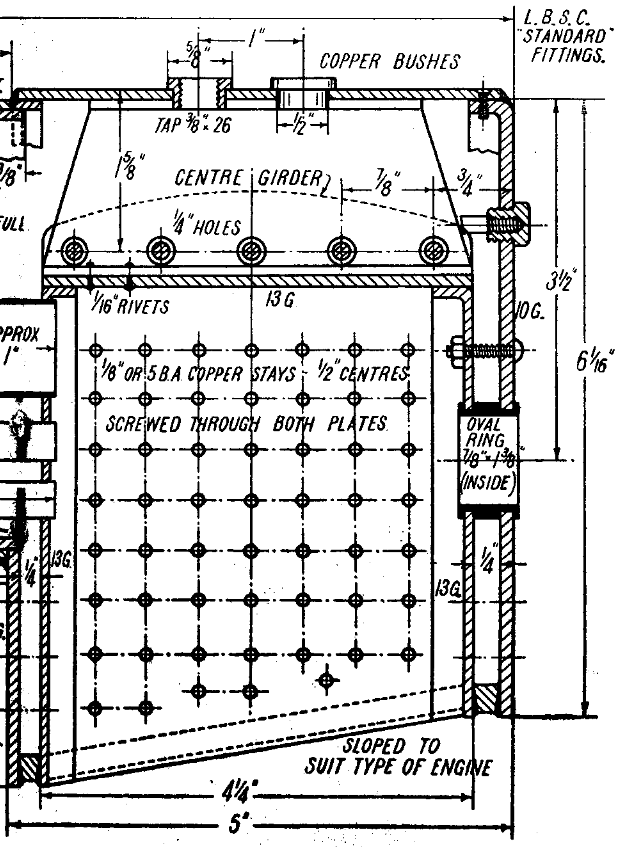
Sections of boiler for small 5-in. gauge locomotive, with multiple-element superheater. Note advantages—50 per cent. more superheating surface over four-flue single-element type; ample gas area around elements, ensuring full superheating efficiency; firebox tubeplate fully utilised; firebox crown, girder stays and wrapper, form a box girder; and medium height of firebox crown allows plenty of water range

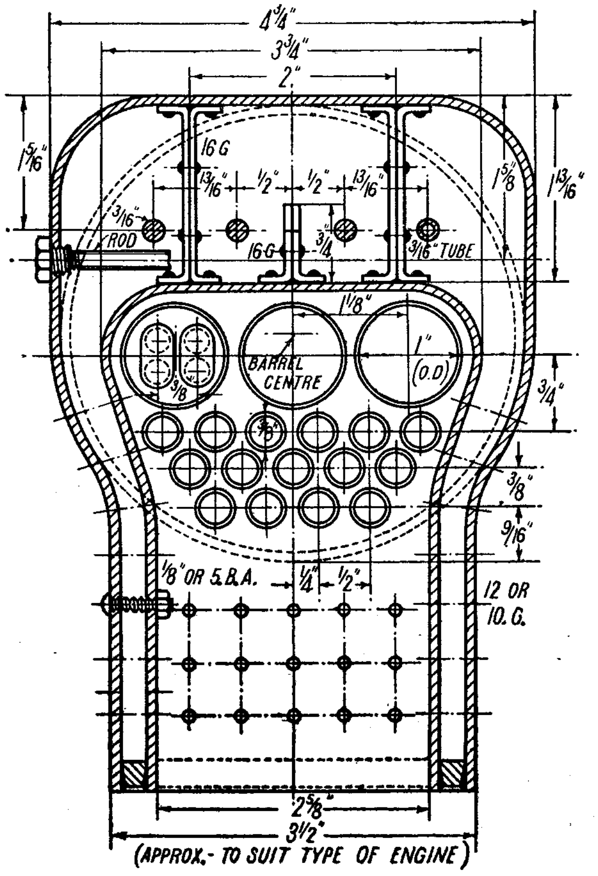
The superheater querists referred to above, nearly all ask for details of a multiple-element superheater suitable for 5-in. gauge boilers. Your humble servant always tries to oblige; so the best thing I can do, is to offer a design for a "universal" boiler suitable for most small types of 5-in. gauge locomotives, such as 0-4-0, 0-6-0, and other smaller kinds of both tender and tank engines. Barrel and firebox length can be altered, if necessary, to suit the job in hand; the layout of the tubes, flues, and superheater, need not be altered at all. The boiler shown, has a Belpaire firebox wrapper; if a round-topped wrapper is desired, simply bend the crown-stay flanges to the radius of the inside of same. The construction is not affected in any way whatever.

There is no need to describe this boiler in full detail, as it follows the "standard practice" which I have evolved during many years of actual personal experience in small locomotive boiler construction; for new readers' benefit, may I add that it is my invariable practice to scrap ruthlessly, any item, or component, or method of construction, that proves in any way faulty; that is why I can personally guarantee results. Literally, the survival of the fittest! Well, getting down to brass tacks, the barrel of the boiler shown, can be made either from seamless copper tube of 13-gauge (3/32 in.) or rolled up from 13-gauge sheet, the joint in that case being lapped for $\frac{3}{8}$-in., riveted, and brazed. Throatplate and backhead are made from 10-gauge ($\frac{1}{8}$ in.) sheet copper, being flanged over an iron former, as described for *Britannia*, the flanges being deep, as shown. The throatplate has a hole cut in it, equal to the inside diameter of the barrel. A "piston-ring" of 3/32-in. copper is fitted to the end of the barrel, being secured by a few rivets, with a bare $\frac{3}{16}$ in. projecting; this projection goes right through the hole in the throatplate. The wrapper sheet may be of 12-, 11-, or 10-gauge sheet copper, bent to shape as shown. It is attached to the throatplate flange by a few 3/32-in. copper rivets, and the joints *brazed*; not silver-soldered. Brass wire, easy-running brazing strip, or Sifbronze should be used, and a good fillet left all around the barrel, also at the top corners of the firebox wrapper. If properly done, the brazing material will "sweat" completely through, making the joints actually stronger than the self-material. The great thing to aim at, is to have the work hot enough to make the brazing material flow freely, without burning the copper. There is little risk of burning the copper with a five-pint blowlamp or an equivalent air-gas blowpipe.

Firebox and Tubes

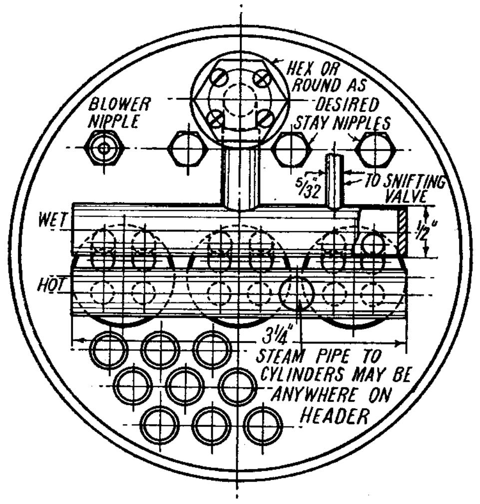
The firebox tubeplate and door-plate are knocked up from 13-gauge copper to the given sizes; the length of the firebox may be varied to suit the particular engine, but its shape is the same. Sides and crown are made in one piece, bent to shape, and riveted to the flanges of the end plates, by just sufficient rivets to hold the parts in close contact for the brazing job. The outer girder crown stays are made from channels, bent up from 16-gauge ($\frac{1}{16}$-in.) sheet





copper and riveted back to back, as shown ; the middle one is bow-shaped, with flanges at bottom only. Rivet these to the firebox crown with $\frac{1}{16}$-in. rivets about $\frac{3}{8}$ in. apart. Then braze all the joints, using the same material as used for the shell. Fully-detailed instructions for these jobs were given in the *Tich* serial, intended for raw beginners.

The smokebox tubeplate is knocked up from $\frac{1}{8}$-in. copper, and turned to a tight fit in the barrel, the tube holes being drilled to the same spacing as shown for the firebox tubeplate. The ends of the tubes should be squared off in the lathe, and cleaned with coarse emery-cloth. Fit the flues and upper row of small tubes first, and silver-solder them; then fit the two bottom rows, and " take a second bite." If you try to do the lot at once, from the inside, funny things will happen to the flame of the blowlamp—if you don't believe me, try it; seeing is believing !—and there will be a subsequent shedding of tears, probably by the builder as well as the boiler. If the tubes are done from the outside, and a fillet of silver-solder allowed to run around each, they will be absolutely and completely leakproof.



Smokebox tubeplate showing arrangement of headers

The firebox-and-tube assembly is then inserted into the shell, the front section of the foundation ring fitted, the upper flanges of the crown stays riveted to the top of the wrapper sheet, and the smokebox tubeplate inserted, the tube ends just projecting through same. The smokebox flange is brazed to the barrel, and the ends of the tubes silver-soldered, allowing a fillet to run around each; the crownstay flanges are also brazed to the wrapper. An illustration showing how to do this job, is given in the *Maisie* book.

Backhead and Foundation Ring

The backhead is then inserted, the position of the firehole being ascertained from the ring already in the firebox door sheet; and if the wrapper won't stick closely to the backhead flange, teach it better manners by aid of a few stubs of screwed 3/32-in. copper wire, screwed through plate edge and flange. The spaces around the bottom of the firebox are filled in with pieces of $\frac{1}{4}$ in. square copper rod, which should be cleaned, and slightly bevelled, to allow the brazing material to penetrate freely, and ensure a sound leakproof job. This, and the backhead, can now be brazed in position, following the detailed instructions I have given so often, and which have proved perfectly effective. As the pieces of the foundation ring should have a few rivets put through to prevent slipping down, when the copper expands under the heat, don't forget to cover the heads with the brazing material. Also take precautions to avoid splashes of acid pickle, when putting the hot boiler in the pickling bath ; this is *very* important. Overalls and clothes are expensive nowadays ; and sulphuric acid does NOT form an ingredient of any face lotion or beauty preparation that I know of—'nuff sed !

Staying

The five wrapper stays, and three of the longitudinal stays, are made from $\frac{3}{16}$-in. copper or bronze rod, secured by blind nipples as shown. The fourth longitudinal stay is made from $\frac{3}{16}$-in. × 18-gauge copper tube, carries the blower valve at the rear end, and a thoroughfare nipple at the smokebox end, to which the blower pipe is eventually attached. The firebox stays are of the same type that Stroudley used in the L.B. & S.C. Ry. locomotive boilers, except that Billy's were riveted over, both inside and out, and mine are nutted on the inside, because you can't get inside to rivet them over. They are screwed through both plates. If the threads fit as well as they should do, the stays should be tight without further treatment; but in case of slack or torn threads, sweat over all the heads and nuts with soft solder. The kind used by plumbers is best, as it has a higher melting temperature than tinman's.

Warning : don't be tempted to try to silver-solder the stayheads and nuts. The process renders the stays brittle, where they go through the plates; and continued expansion and contraction stresses, aided by the pressure variation, will eventually cause fracture. That was something else that I found out by experimenting ! When the staying is completed, test the boiler by water pressure to about 160 lb., and no more. Excessive test pressures do harm, for they unduly strain the joints, and weaken them at the outset, so that the boiler is far more liable to fail in service, than if tested at a moderate safe pressure. Full-size boilers are never strained by excessive test pressure.

Superheater

The whole bag of tricks is shown clearly—anyway, as clear as a self-taught person can draw it; I guess that if I can understand it myself, anybody can !—in the accompanying illustration. Any type of dome regulator that I have described in these notes, would be suitable; *Molly's*, for example. The $\frac{3}{8}$-in. main steampipe terminates at the smokebox tubeplate in a flange, with the usual internal and external similar-pitched threads. The head may be hexagon if desired, for ease of screwing home. A $\frac{1}{2}$-in. slice of similar material is attached to the flange by four 6-B.A. screws, and carries a $\frac{3}{8}$-in. pipe which is connected to the upper or " wet " header. Both this and the lower or " hot " header are nothing more formidable than $3\frac{1}{4}$ in. lengths of $\frac{1}{2}$-in. × 18- or 20-gauge copper pipe, plugged at the ends with discs of $\frac{1}{16}$-in. copper.

There are six elements (two in each flue) each composed of two pieces of $\frac{1}{4}$-in. copper tube, of 20 or 22 gauge. For a boiler made to the dimensions shown, the upper one should be $9\frac{1}{4}$ in. long, and the lower one 10 in. They are joined at the firebox end by a block return bend made from a piece of copper $\frac{3}{4}$ in. long, $\frac{5}{8}$ in. wide, and $\frac{5}{16}$ in. thick, filed to shape, and drilled as shown. The pipes must be *brazed* into the bend; silver-soldering won't do at this end. I use either brass wire or Sifbronze, and never get any trouble. The other ends are fitted into holes drilled in the headers, and the whole lot silver-soldered, as smokebox heat isn't so fierce—on my boilers, at any rate ! They can, of course, be brazed by any-

(*Continued on page* 657)

An improvised vertical slide

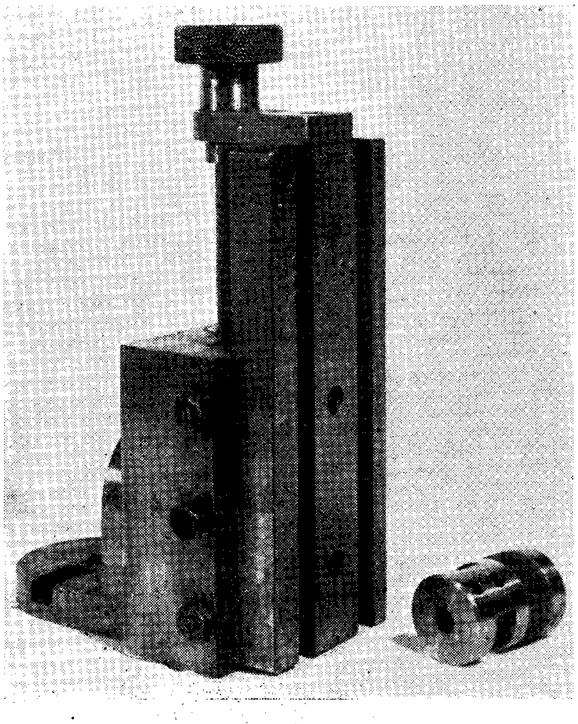
By "Base Circle"

ONE of the most generally useful adjuncts to the lathe is the vertical-slide. Indeed, if the lathe is to act as a complete machine shop, as it perforce must in most home workshops, then a vertical-slide of some kind is wellnigh indispensable. Without it, milling must be confined to work such as cutting slots with the work carefully and laboriously—oh, so laboriously!—packed up to the correct height. The old round-bed Drummond, of happy memory, did make some attempt at providing the necessary height adjustment, but even with one of those excellent old machines, milling was rather restricted. Again, if gear-cutting is to be attempted in the lathe, some form of vertical adjustment for the cutter or the work must be provided. The vertical-slide can be used for gear cutting, as well as for all sorts of milling jobs which would otherwise be out of the question.

In the case of the "Base Circle" workshop, the need for a vertical-slide became apparent at a very early date, and various ways and means of supplying the deficiency were considered. The only way which did not receive any attention was the rather obvious one of purchasing one. The "Base Circle" workshop is, you see, situated north of the border!

The possibility of using the top-slide of the lathe itself (a $3\frac{1}{2}$-in. Drummond) mounted on an angle-plate was given some thought, but the idea was soon abandoned, as the Drummond top-slide did not appear to lend itself to such a conversion very well. The next thought was to obtain somehow a top-slide from a heavier lathe, so a visit was paid to a local scrap dealer's premises, where it was known that machines which had outlived their usefulness were sometimes scrapped. (This was, of course, before the war. During and since the war, such machines would be nicely painted and sold for three times their original price!) However, the visit proved fruitless, as the only slide available was a huge one belonging to a machine of twenty-four inches centre height.

It would, of course, have been possible to build up a vertical-slide from castings, but the idea of pattern making did not appeal, so, like Mr. Micawber, we just waited for something to turn up. Well, something did eventually turn up. During a later visit to the same scrap yard, a very ancient Potter and Johnson automatic chucking lathe was found. The machine itself was a wreck, but on the turret were mounted two very attractive auxiliary slides which, unlike the machine itself, appeared to be in good condition. This will often be found to be the case, as such pieces of equipment are not constantly in



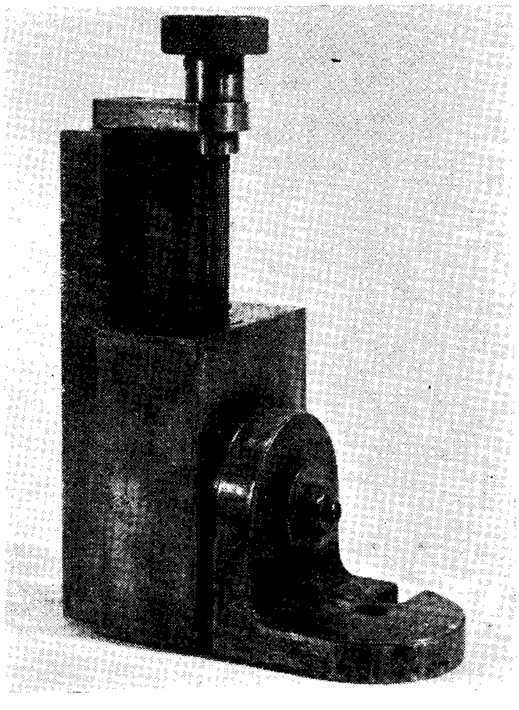


Fig. 1. Front and back views of the slide and cutter holder

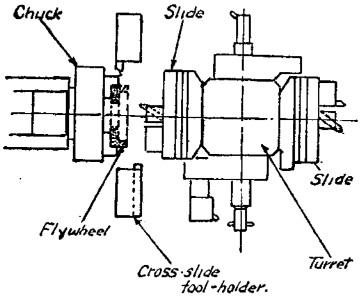


Fig. 2. Turret lathe layout, showing use of auxiliary slides

use like the machine, but are only used for occasional jobs. Well, these slides appeared to be just what was wanted for our purpose, more especially as they had two ⅜-in. tee-slots running lengthwise. It would have been better if they had been a little wider, but one cannot have everything, so that point was ignored. It may be of interest to consider briefly how these auxiliary slides are used. Fig. 2 shows, roughly, the layout of tools on an automatic. The job shown in the chuck has a recessed face, and it is for work like this that auxiliary slides are necessary. Obviously the face cannot be machined from the cross-slide, so the facing tool is mounted on the auxiliary slide—the turret advances to a stop—and then the cross-slide goes forward and pushes the auxiliary slide across, thus facing the recessed surface. As shown on the diagram, the first slide will rough the face while the second will finish it. Such slides are quite commonly used on both auto and hand-operated turret lathes, and they can be picked up from time to time if one has patience enough. Well, one of the slides was acquired for the proverbial old song, and carted home to the workshop. It has always been a matter of regret that the other slide was not bought, too, as it would undoubtedly have been found useful for something or other.

Fig. 3 shows the slide practically as it was bought. Indeed, the only changes are the addition of a few tapped holes. There are recesses at the back—they can be seen in the photograph—which housed the springs that returned the slide at the end of its stroke, but these do no harm, and as they do not now serve any useful purpose they are not shown in the drawing. It was intended to use the bracket in which the slide fitted, but it was found to be rather heavy and clumsy, and it was decided that it would be easier to make a new one than to modify the existing one. The base as made is shown in Fig. 3. It was roughed out on a power-driven shaper, and finished on the hand-machine in the workshop. It will be seen that a solid block of steel was used. A casting would have saved a considerable amount of work, but at that time it was easier for the writer to obtain pieces of steel than castings.

The photographs, show back and

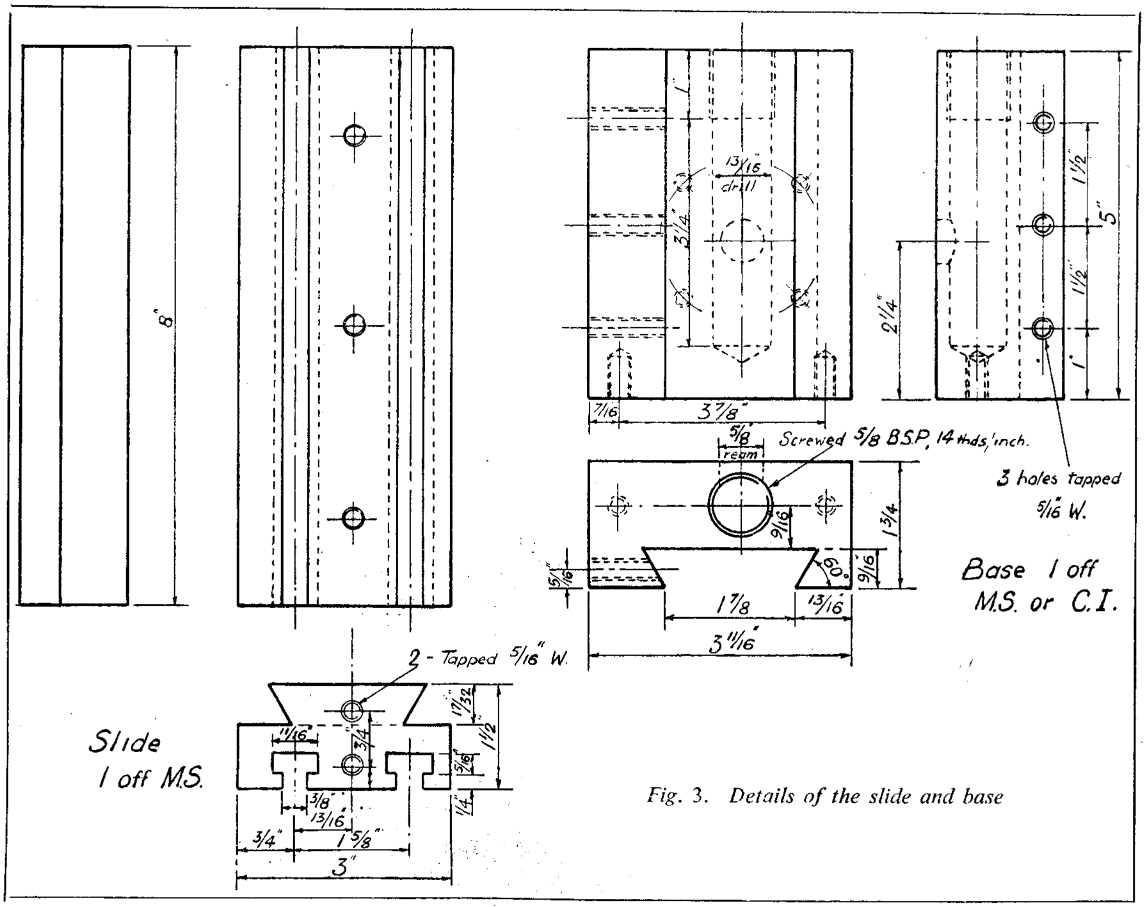
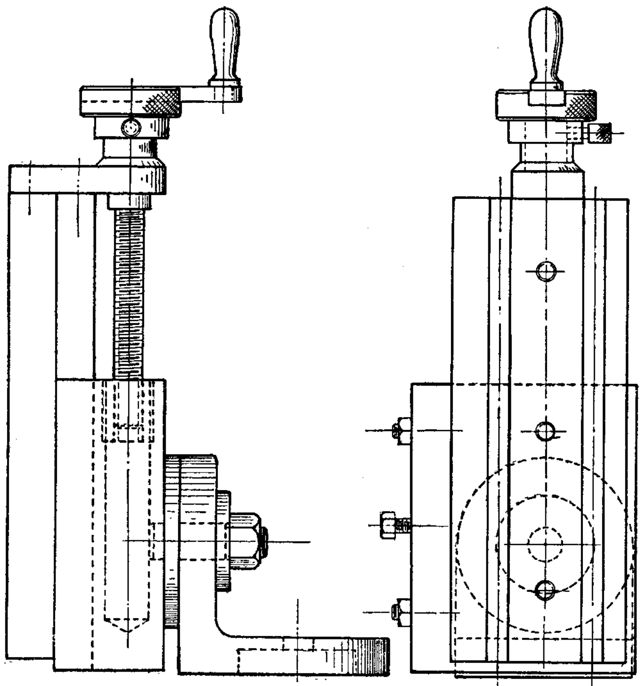


Fig. 3. Details of the slide and base

front views of the finished tool. It will be seen that a slide of the universal type was decided on, but I don't know that the decision was a wise one. Over the years I can recall only a very few occasions when the angular adjustments were used, and it has always to be remembered that the more adjustments there are, the less rigidity there will be. Of course, the slide as made gives practically all the movements of a universal milling machine on a small scale, whereas a plain slide would only approximate to a plain mill. In any case, later on when heavier work was being done, the problem of rigidity was solved fairly satisfactorily, as shown in Fig. 5. Here the slide is firmly screwed to a special well-ribbed angle bracket, having provision for several bolts to fasten it down to the lathe cross-slide. This set-up will permit as heavy cutting as is good for any 3½-in. lathe. In its universal form, the slide is quite suitable for the usual light milling required in model engineering in brass, cast-iron or small steel parts, but it is certainly inclined to chatter when anything like a heavy cut is attempted. The fault is, of course, too much overhang from the bolt which holds the angle-bracket to the cross-slide, and this defect is largely overcome by the use of the alternative bracket. In spite of its defects, the slide has done a lot of useful work. For example, it may be mentioned that gear teeth up to 14 d.p. have been cut with a cutter



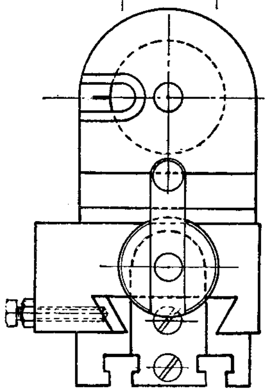


Fig. 6. Three views, showing the general arrangement of the slide

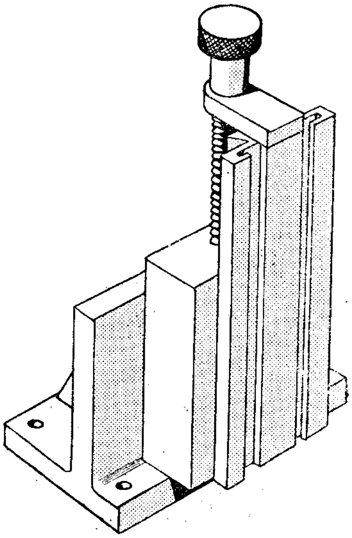


Fig. 5. Sketch showing slide mounted for heavier work

spindle mounted on the slide, and driven by a large handwheel rotated by hand. The handwheel was on temporary loan from the family mangle. At the other end of the scale, the slide has been used in the cutting of clock gears, including ratchet gears for electric clocks.

Fig. 6 gives a general arrangement of the slide. The feedscrew, it will be seen, is carried on a bearing-plate screwed to the upper end of the slide, and engages in a nut screwed into the slide base. To the base is screwed an index-plate graduated in degrees. This plate is extended to form the pivot, which fits in a reamed hole in the angle-bracket. This bracket is arranged to swivel round the special bolt which, on the Drummond lathe, normally bolts the top-slide to the cross-slide. The index-plate which is used with the top-slide is also used with the vertical-slide, thus avoiding the cutting of another division plate. The slide is fitted to the base with a ¼ in. thick gib strip, which is adjusted by two screws with lock-nuts to give a good sliding fit free of any slackness. The central screw is used for locking the slide when taking a cut. It may be noticed that on this drawing a loose index collar is shown fitted to the feedscrew, although it does not appear on the photograph. This is a later improvement, as it was found that the original fixed collar entailed too much mental arithmetic and caused too many mistakes. The crank handle, too, is an addition which will be found well worth while.

Fig. 3 gives full details of the slide and its base. The dimensions, of course, would require to be modified to suit the slide available. The method shown for fixing the nut to the base is possibly not altogher to be recommended. It would be easier to make the nut with a flange which could be held down to the base by two or three screws. The only advantage of

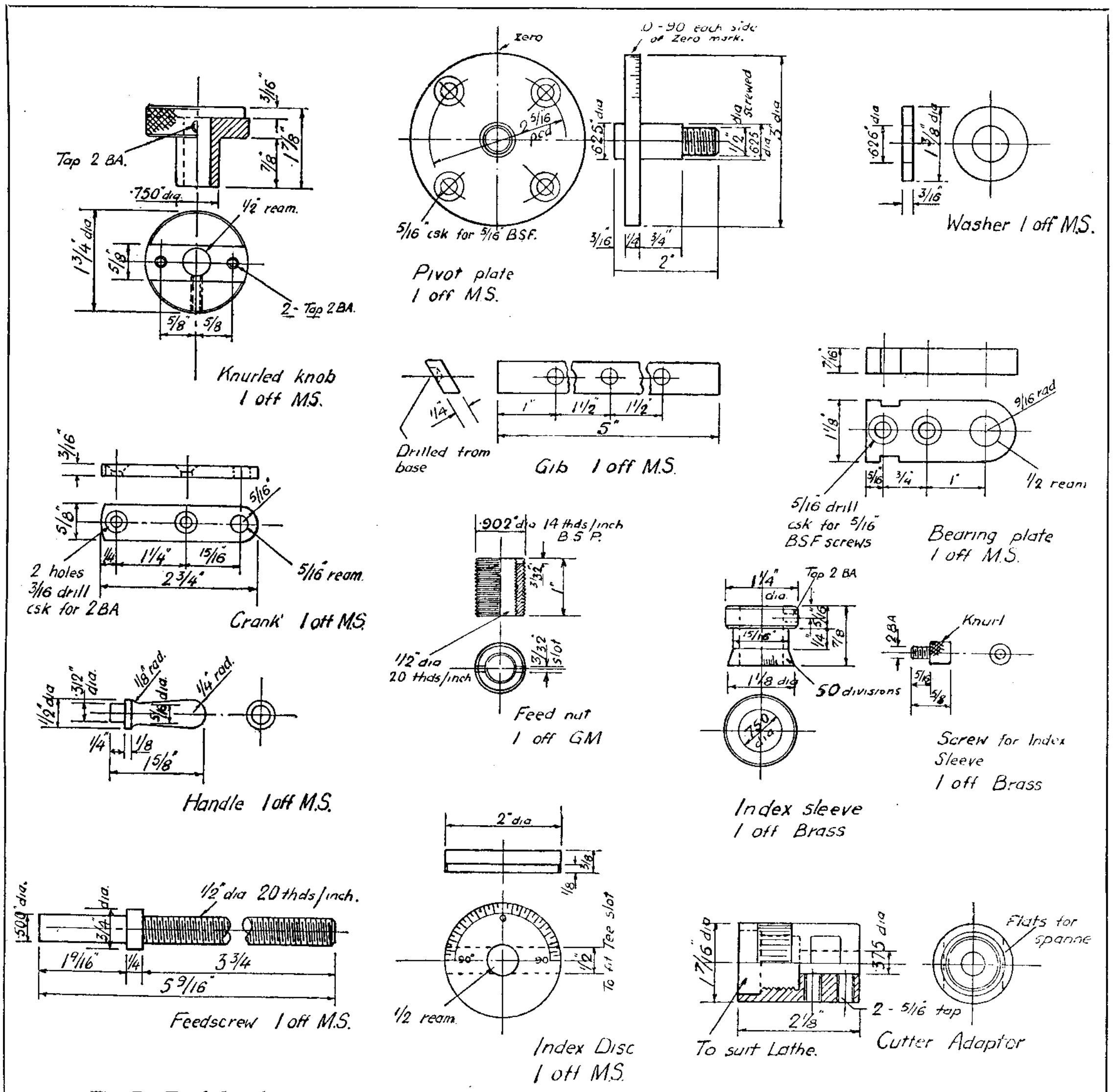


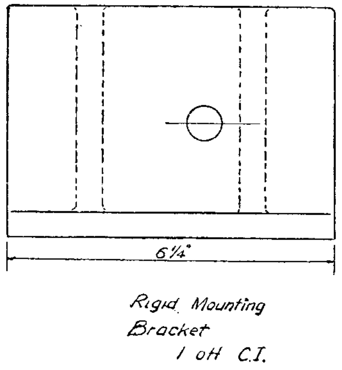
Fig. 7. Feed details

Fig. 8. Some of the smaller items

the method shown is that it avoids restricting the travel of the slide, and this was the reason it was adopted. The screwed nut is locked by a half-and-half screw which is not shown on the drawing. The vee-slide in the base was shaped out roughty on a power shaper, and carefully finished on the workshop hand-machine. Only the side of the vee away from the gib requires to be scraped to a perfect fit to the slide. The other side is quite good enough as machined. The top surfaces must, of course, be bedded down on both sides. The gib must be flat on the side which bears on the slide and should, for the sake of appearances, fill the gap between slide and base reasonably well. It may seem unnecessary to labour the point about screw-adjusted slides only requiring fitting at the solid side, but I do so because I have known experienced fitters to spend time laboriously scraping up such a slide all over, forgetting that the adjusting screws would push the gib away from the carefully scraped surfaces. It would be quite otherwise in the case of a taper gib, but not many of us are likely to try fitting a taper gib, although it would be a much better job.

Fig. 7 shows some of the details in connection with the feedscrew and handle. The screw itself is screwed twenty threads per inch, so that fifty divisions on the collar give thousandths of an inch movement of the slide.

Fig. 8 shows further small details, including the graduated ring. This is turned to a good push fit in the $\frac{5}{8}$ in. reamed hole in the back of the base and to a good fit, free from any slackness, in the angle-bracket. The feed-nut is screwed 14 threads per



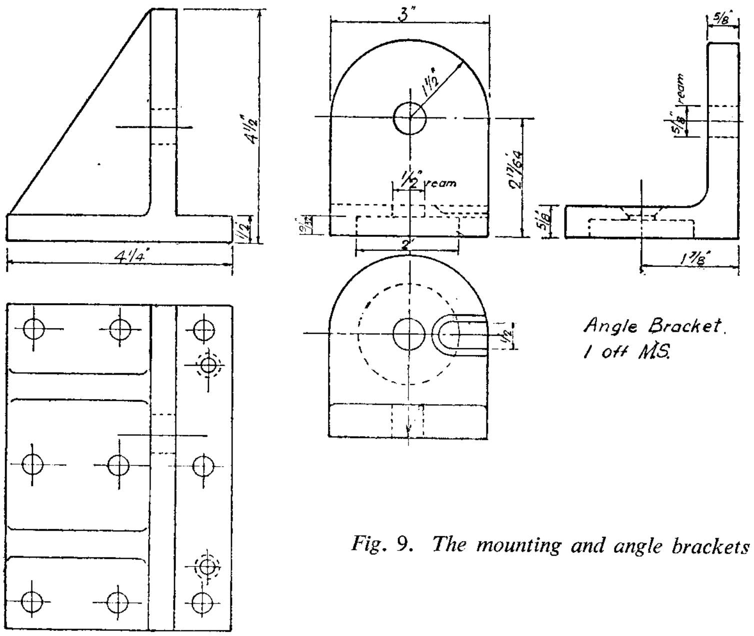


Fig. 9. The mounting and angle brackets

inch pipe thread outside and 20 threads per inch inside. The index collar is divided into fifty as shown. It is, I should imagine, unnecessary to go into details about how to carry out this operation—it has been fully explained more than once in these pages. With a good selection of change wheels, and a little ingenuity, it is possible to deal with most dividing problems. The Drummond index-plate is illustrated, as it may not be familiar to everybody. It will be seen to be merely a disc which fits into a recess in the top-slide, or in our case in the angle-bracket, and having a tenon which fits in the tee-slots in the cross-slide. It is graduated on the top surface as shown, and readings are taken through the slot in the angle-bracket. The disc is a good fit on the tee-bolt on which the angle-plate pivots.

Fig. 9 gives details of the angle-bracket, and also of the special heavy bracket for use on heavy work. Only overall dimensions are given, as the bracket would have to be made to suit the machine. The main thing is to make the bracket heavy enough to give the required rigidity.

In the photograph, beside the slide will be seen a special adaptor for carrying the milling cutter. This is detailed in Fig. 8. It is merely a short piece of mild-steel screwed to fit the spindle nose and having a bore at the other end to take the cutter. In this case, the bore is ⅜ in. to suit some surplus cutters which were picked up. Some such adaptor is an absolute necessity for milling, as it is almost useless to mount the cutter in the chuck. To do so means far too much overhang from the machine bearings which are, after all, not designed for milling at all. Many good turners do not realise how much more rigidity is required when milling than when turning. Even at the best, the lathe is but a makeshift as a miller, and to get results at all, everything must be done to avoid overhang and slackness, which will inevitably cause chatter. The cutter must be close to the bearings, the cross-slide must be adjusted as tightly as possible, and locked if it is not being used for feeding; the vertical-slide, too, must be as tight as possible and locked except when feeding, and finally the saddle itself must be locked to the lathe bed. Its length of bearing on the bed is only too often far from adequate, even as a lathe, and if there is no provision for locking it, a lock of some kind must be contrived. Only when all these points have been attended too will our attempts at milling meet with reasonable success.

L.B.S.C.'s Lobby Chat

(*Continued from page* 652)

body who prefers it; but in that case, the steam-pipe flanges should be either copper, or cast in plumber's weldable metal.

A 5/32-in. pipe, for connection to a snifting valve, is attached to the upper header as shown; air drawn through it, circulates through the elements, and doesn't cool the cylinders. Steam connections from the bottom header, are attached in the most convenient place to suit the engine. If she has inside cylinders, a single pipe will suffice. If outside cylinders, with inside steam-chests connected by a cross pipe, a single pipe between the header, and a tee on the cross pipe, would also be a suitable arrangement. If outside cylinders with valves on top are used, two steampipes arranged as recently illustrated for *Britannia*, would fill the bill. The superheater is, however, easily adaptable to any pipe arrangement desired, and can even be applied to a traction engine. Well, I guess that is all there is to say, at the moment; but should anybody need further help or advice, they have only to sing out. I'm here to do my best for all, as far as I'm able; and my many years of actual experience are at your service, as needed.

FITTING WOODRUFF KEYS

By "Duplex"

THE backgear of a 4 in. lathe, having the two gear wheels secured to the $\frac{3}{4}$ in. diameter shaft by set-screws only, was found to have developed excessive backlash as a result of wear in the wheel fixings. It was decided, therefore, to refit the parts by cutting Woodruff keyseats in the shaft and machining keyways in the gears themselves, leaving the set-screws, previously taking the drive, to serve only for locating the gear wheels lengthwise on the shaft.

For those unfamiliar with the principle of the Woodruff key, the diagram, Fig. 1, shows that the key itself is roughly of semi-circular shape and fits closely into a corresponding recess milled in the shaft. Standard $\frac{1}{2}$-in. keys range from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. in thickness and, when fitted, the key projects above the shaft for a distance equal to half the thickness of the key.

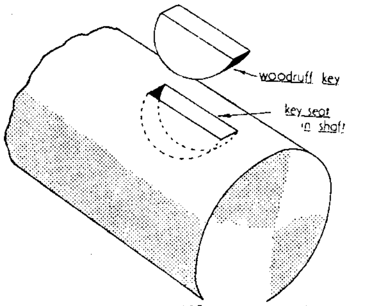


Fig. 1. A Woodruff key and its keyseat

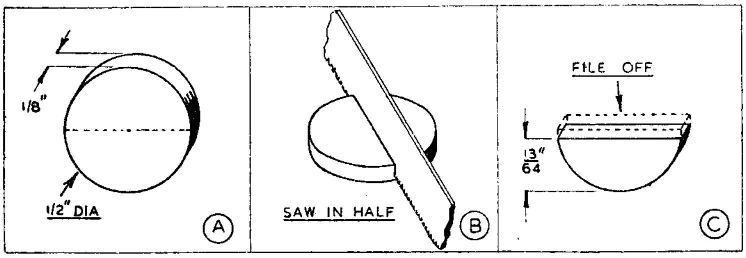


Fig. 2. Steps in making a Woodruff key

Making Woodruff Keys

Although standard Woodruff keys are usually bought in the finished state, they can be made quite easily from silver-steel rod in the way shown in Fig. 2.

A $\frac{1}{2}$-in. key is first turned to the finished diameter and then parted off a few thousandths of an inch in excess of the finished thickness to allow for subsequent fitting. Next, the blank is sawn in half and afterwards filed down to the finished height, which is normally made less than half the diameter.

Making Woodruff Cutters.

These cutters are somewhat expensive, but, again, they can be made in the workshop without much difficulty.

A typical $\frac{3}{8}$ in. diameter, home-made cutter is shown in Fig. 3, and its dimensions are given in Fig. 4. In accordance with the machining operations represented in Fig. 5, the cutter blank is first machined from a length of silver-steel.

It is important to form the teeth exactly concentric with the shank of the cutter, and a draw-in mandrel collet chuck provides an accurate and convenient means of mounting the work, for there is then no interference from the jaws, as may happen when a larger chuck is used. The diameter of the neck is made as small as possible consistent with adequate strength, as on this depends the depth to which the keyseat can be cut.

Six cutting teeth are sufficient for a small cutter, and these need not be exactly indexed, as these tools sometimes cut better when the teeth are irregularly spaced. However, the finished cutter looks better when the teeth are evenly spaced, and this can be done with reasonable accuracy if the end face of the shank is marked-out accordingly. Grip the shank in a V-block resting on the surface plate and scribe a line through the centre with the surface gauge. Then scribe a second diagonal through the centre with a 60 deg. set-square resting on the surface plate; finally, turn the set-square over and scribe a third diagonal.

After an end-mill has been gripped in the collet chuck, the work is mounted in the lathe toolpost at right-angles to the lathe axis and, as shown in Fig. 5C, the centre-line of the work is set level with the lower edge of the mill. When cutting the first tooth, one of the scribed lines is set upright with the aid of a small try-square. The tooth is then machined to the full depth by taking a series of cuts in accordance with Fig. 5B.

The rest of the teeth are indexed from the remaining scribed lines, and then cut in the same way by feeding the cross-slide inwards. Run the mill at a moderate speed and use

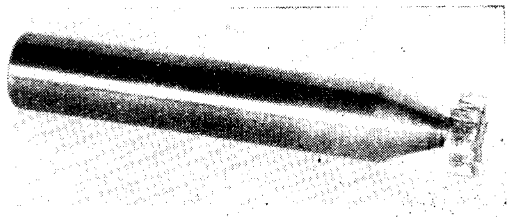


Fig. 3. A keyseat cutter made from silver-steel

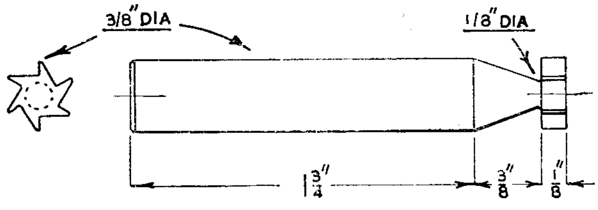


Fig. 4. Dimensions of a small keyseat cutter

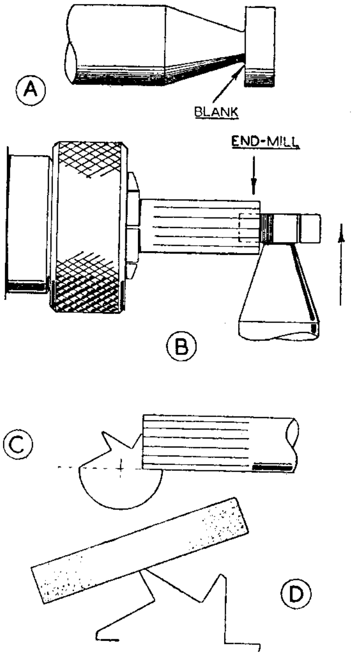


Fig. 5. Stages in machining a keyseat cutter

plenty of cutting oil. After the cutter has been hardened and tempered, the teeth are given the necessary cutting clearance in the way shown in Fig. 5D. When grinding the teeth free-hand in this way, the ground facet should fall short of the cutting edge by a few thousandths of an inch, so that the narrow land formed can be accurately honed with a hand-slip.

Finishing the teeth, of course, requires care and some manual skill, but in practice no difficulty has been found when sharpening home-made cutters in this way, and they certainly cut well.

Machining the Keyseat

With the finished cutter set to run truly in either the four-jaw or a collet chuck, the shaft is mounted on the vertical-slide, so that a feed motion is available for machining the keyseat to the required depth.

The two commonly used methods of securing the work to the vertical-slide are illustrated in Figs. 6 and 7. But before starting the machining, the cutter must be accurately centred on the work to ensure that the key, when in place, is positioned radially.

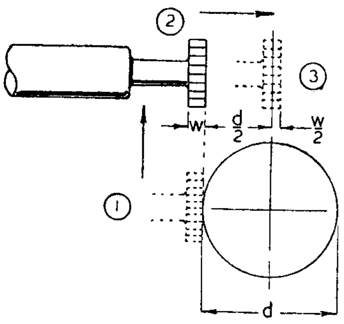


Fig. 8. Method of centring the cutter on the work

One method of doing this is illustrated in Fig. 8; that is to say, the width of the cutter and the diameter of the shaft are measured with the micrometer, and the work is first brought into contact with the cutter and then moved to the left for a distance equal to half the width of the cutter, plus half the diameter of the shaft.

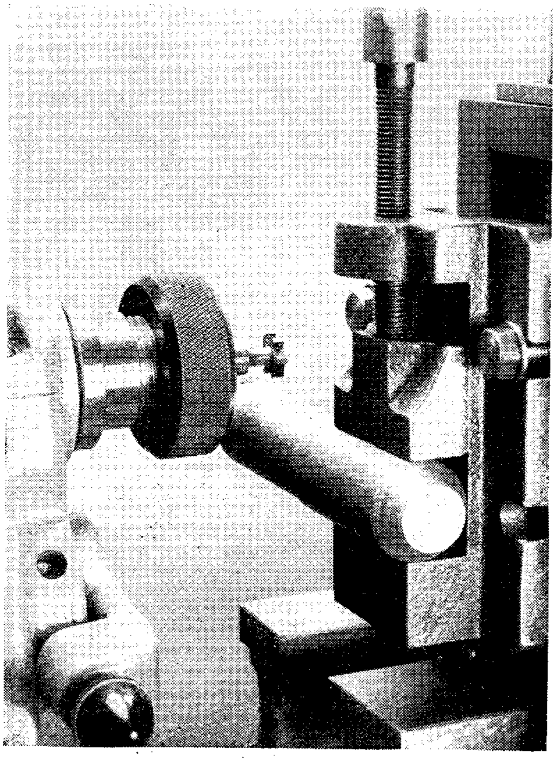


Fig. 6. The shaft held in a machine vice secured to the vertical slide

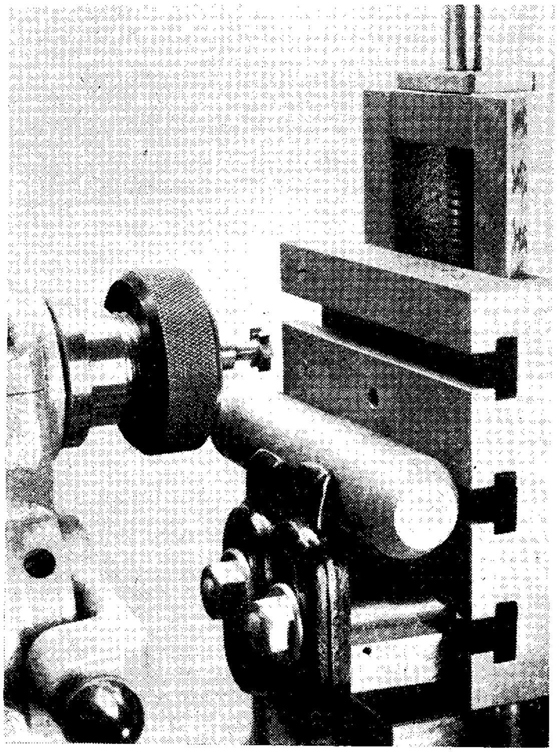


Fig. 7. Securing the shaft with clamps

The cutter, running at a moderate speed, can now be fed into the shaft, and the depth of the keyseat, as measured from the feedscrew index collar, should be such that the key, when in place, projects for a distance equal to half the thickness of the key itself. An alternative method of cutting the key seat is that shown in Fig. 9. Here, the shaft is gripped in the chuck and supported by the fixed steady; the milling attachment is secured to the lathe cross-slide, and the cutter is set at centre height. After the mandrel has been locked, the keyseat is cut to depth by feeding the cross-slide inwards.

Fitting the Key to the Shaft

As previously stated, the key is parted off a few thousandths of an inch thicker than the finished size. To fit the key to its seat, the key is, therefore, carefully rubbed on a file until it can be firmly pressed into place. When required, these keys can be easily removed by tapping one end with a piece of brass rod.

Before assembling the wheel on its shaft, remove any burrs round the keyseat and try the wheel in place without the key.

After seating the key, smear it with marking paste and engage the wheel ; the transfer marks will then show if the sides of the key need light scraping, or if the top of the key has to be filed to give clearance.

Forming the Keyway in the Gear Wheels

The old-time wheelwrights cut closely-fitting keyways with cold chisel and file only, and, at times, we have had to adopt this method when dealing with work too large for any of the machines available; but it is a job needing great care to obtain an accurate fit. The method used in the present instance is illustrated in Fig. 10. A tool of the same width as the key and shaped like a parting tool is set with the centre of its cutting edge at centre height and, after the mandrel has been locked, the tool is moved backwards and forwards by using the lathe rack-gear. Only light cuts should be taken, by feeding the cross-slide away from the operator.

On previous occasions, we have described using a Nulok tool-holder with an inset cutter for machining internal keyways, and the tool is then drawn through the work; nevertheless, the method outlined above has proved entirely satisfactory, and enabled the Woodruff keys to be fitted to the backgear wheels quite accurately.

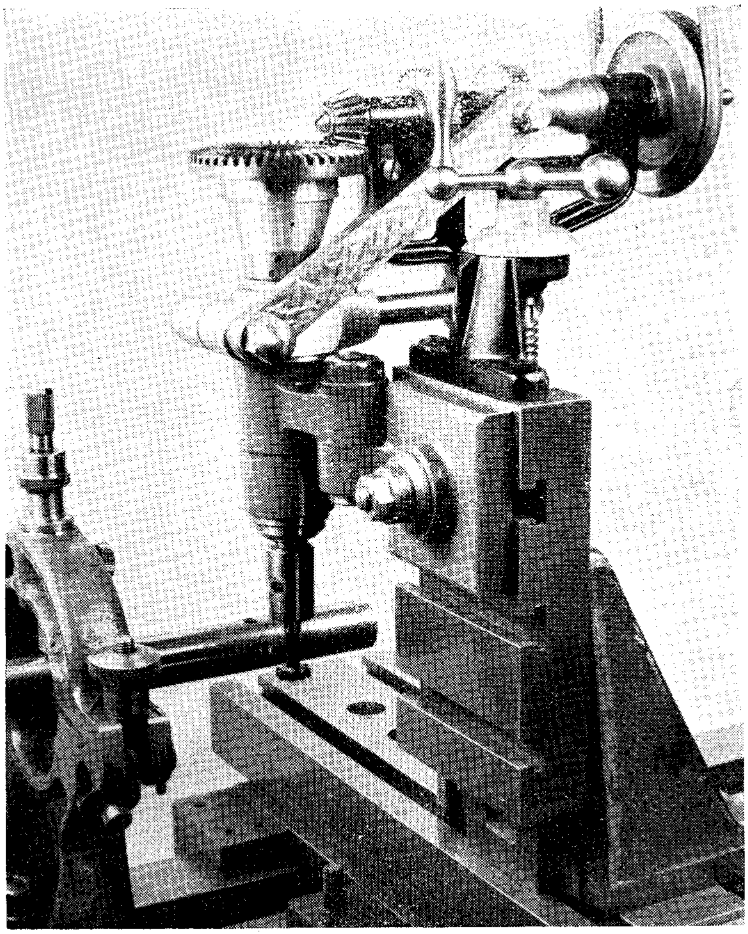


Fig. 9. Cutting a Woodruff keyseat with a milling attachment

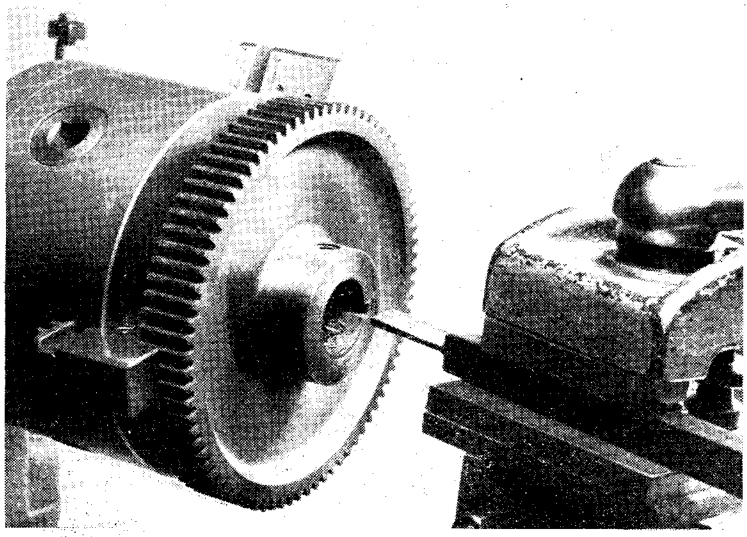


Fig. 10. Cutting the keyway with a parting tool

True centring in the lathe

By Lawrence H. Sparey

IN the correspondence columns of THE MODEL ENGINEER there appeared recently a letter from Mr. L. A. Watson, of Croydon, in which he stated that he knew of no method by which a bar could be truly centred by any means available to the amateur. Such a method does, in fact, exist, and he and others may care to know of it. The system is by no means original, as I first encountered it some years ago, in the toolroom of a large London works in which I was employed for a considerable time.

During this period I was attached to the machine-tool repair department of the toolroom, which was engaged in the maintenance and repair of almost every conceivable type of machinery. Some of the overhauls were extensive, amounting to a complete rebuilding of the machines in question, and involving such operations as regrinding the beds of lathes and millers, and the regrinding of the mandrels in preparation for the fitting of new bearings.

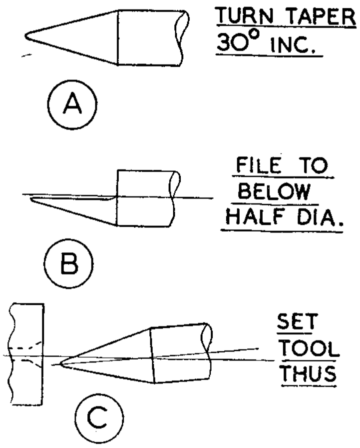
In regrinding such mandrels it is the practice to refinish only the actual bearing portions, leaving the threads, chuck registers, and the internal taper intact. Apart from the fact that these mandrels were usually hardened, any machining of these parts would, of course, have meant the fitting of new backplates to all the chucks, with the possibility of new lathe centres and collet fittings. In these circumstances it was essential that the new bearing surfaces be truly concentric with the original portions of the mandrel.

Now, this type of grinding is carried out *between centres*, so that it is necessary that the spindle itself be supplied with centred holes of extreme accuracy. This requires that the open ends of the spindle be fitted with metal plugs—using a plain plug at the tail end of the spindle, with a tapered plug in the internal taper. These plugs must then be centred truly with the chuck register and threads.

Centring the Plugs

Although the following notes are written as if applying only to this specific job, it is obvious that they apply also to the centring of any circular shaft.

Before inserting the tapered plug, the spindle was mounted in the lathe, gripping the tail end in a four-jaw chuck, with the nose end supported temporarily by the tailstock centre. The portion of the spindle, close up to the four-jaw chuck, was then set to run truly by means of a dial test-indicator or " clock." The outer end of the spindle was now supported, on the chuck register, by a *fixed steady*, after which the tailstock support was withdrawn. The fixed steady was now adjusted ; clocking along the spindle to ensure that it was parallel to the lathe bed. It should be noted that this last clocking process is not necessary when mounting plain, one-diameter shafts in this manner, because the fixed steady may be adjusted close up to the chuck jaws, and then moved along the lathe bed to the outer end of the work.



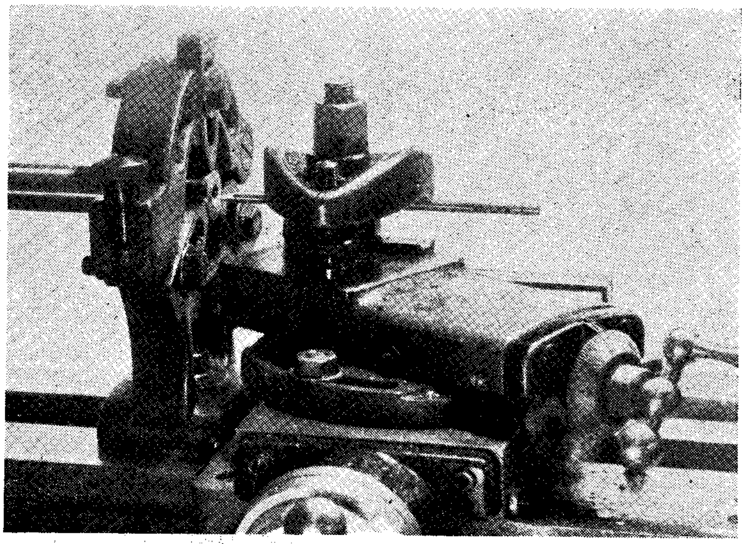
When thus truly mounted, the taper plug was inserted, and tapped home. Then, using a large centre-drill, the plug was centred from the tailstock.

Boring the Centre

The plug may now be considered to be roughly centred, but for absolute accuracy it is necessary to bore out the centre hole at the correct angle—60 deg. inclusive. This is done with the small boring tool illustrated in the drawing.

Looking at this, we see that the tool is formed by tapering off a length of silver-steel to an angle of about 30 deg. *inclusive*, and by reducing this tapered portion to just below half of its diameter. In the actual making of the tool it is better

(*Continued on page* 663)



Centring a bar truly by means of boring in the fixed steady

HOW SPRINGS ARE MADE

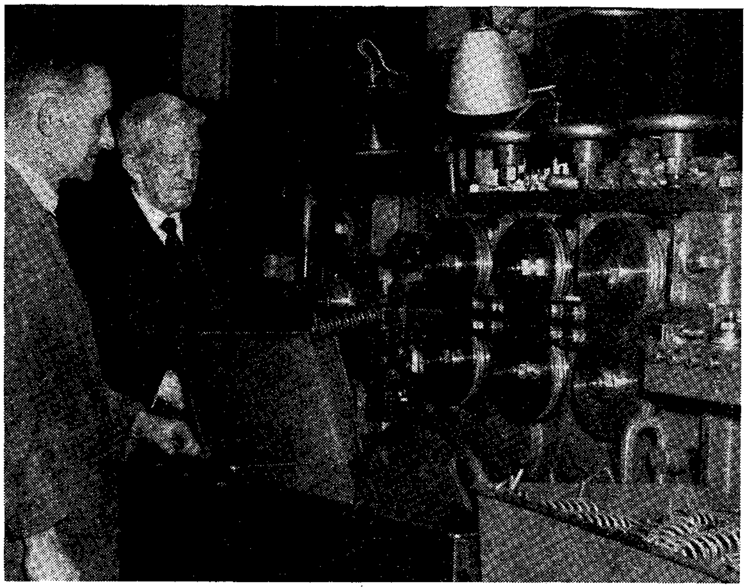
The "M.E." visits Messrs Herbert Terry & Sons Ltd., Redditch

IN all kinds of mechanical engineering, springs play an important and indeed vital part, yet comparatively little is known either about their design or production by the average engineer. There are few readers of this journal who have not, at some time or other, encountered problems in the application of springs, and in the absence of a suitable ready-made spring, realised how difficult it is to make one which will perform the required function. That being so, it is felt that some information on their manufacture will be of general interest.

We were privileged recently to pay an informal visit to the Redditch works of Messrs. Herbert Terry & Sons, Ltd., whose name is familiar wherever springs are used—and that means everywhere. The town of Redditch, situated near the heart of the industrial Midlands, is noted for its production of small but high quality steel goods. Not only can Redditch make a little steel go a very long way, but it can manipulate steel in a way which is unrivalled anywhere in the world; and Terry's products live fully up to local traditions.

One of the first impressions received on entering the factory is its vast size and the immense amount of material required in view of the fact that the individual products are mostly quite small. But equally astonishing is the very wide variety in shapes, types and sizes of springs, and the diversity in the machinery and processes applied in producing them. The prevailing idea that the need for craftsmanship is declining in modern industry is certainly not true in spring manufacture, for although the most up-to-date modern machines and methods are exploited to full advantage, the skill of the individual craftsman is equally essential to success in this highly specialised work.

As might be expected, coil springs form a large proportion of the factory output, including valve springs for internal combustion engines. Every normal motor car uses at least eight of these springs, not to mention marine, aircraft and industrial engines—and Terry's make most of them. Except where special duty is involved, these springs are made from hard-drawn wire, either of ordinary carbon spring steel, or special alloy steel, and are formed without pre-annealing. The common workshop method of winding springs on a mandrel is used only for special small-quantity jobs; for rapid production of similar types, machines of a most ingenious type are used in which the wire, fed by friction rollers, is pushed against grooved coiling pins which deflect it into a circular path and also produce the required pitch angle, or "spacing" of the coils.



Mr. Charles Terry, C.B.E. (right) supervising the setting of a machine for making valve springs

By this means it is possible, by varying the position of the coiling pins while the coil is being wound, to influence either the diameter or pitch of the springs, so that they may be made tapered or barrel shaped, or the end turns may be close wound to assist squaring off. The coiling pin movements are controlled by cams, and when the required numbers of turns have been wound in each case, the wire is sheared by a cam-controlled cutter. It is fascinating to watch these machines winding and chopping off the springs at intervals of only a few seconds, though their movements appear to be deliberate and unhurried.

After winding, the springs are ground flat at each end, by means of a machine having a battery of bushes in which the springs are loosely placed, the batch then being swung into position between the faces of two parallel grinding wheels, which are then advanced towards each other, the springs being allowed to float as the ends are ground true, and to a uniform length. In normal practice, the springs are not subsequently hardened and tempered, but are subjected to a low-temperature heat treatment which relieves internal stresses without drawing the temper. They are then given a shot-peening process which renders the springs more resistant to fatigue stresses. Except for springs which have to be plated or given other special finish, this completes their actual manufacture.

All springs are finally tested on machines which apply a fixed load, and the deflection of all in a given

batch must agree within close limits to enable them to pass inspection. Many of these and other testing machines are designed and made in the works.

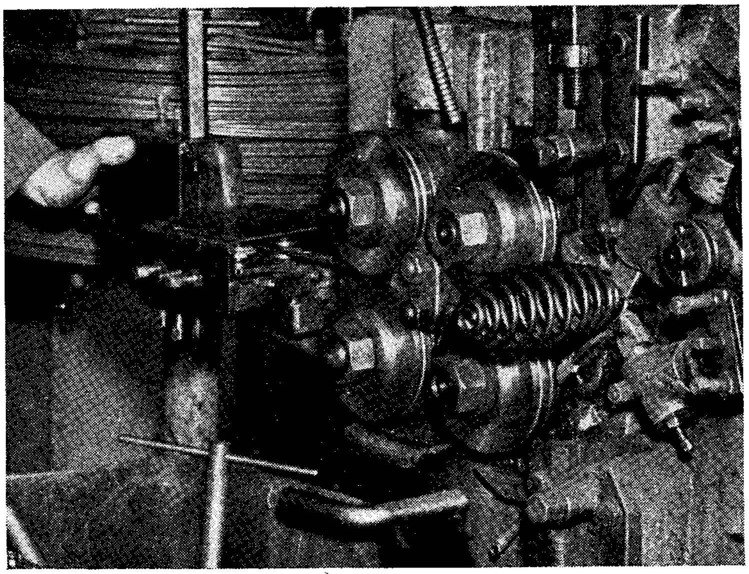
Flat springs, in most cases, are made from annealed spring steel strip, in machines of complex design which crop the length required and form all bends simultaneously; they are then hardened and tempered either in a combined process, consisting of hardening heat, tempering heat and quench, or hardened in an atmosphere controlled conveyor belt furnace, quenched and then tempered as a separate process, in an electric air circulating furnace.

Similar treatment is given to other pressed steel tempered products, such as the well-known Terry spanners, tyre levers and similar tools.

The research department of the factory is by no means the least important, and is kept fully occupied in solving customers' problems, investigating future possibilities, and also in routine tests on raw and finished materials. Another important department is the large and well equipped tool-room, which is necessary to keep in concert pitch the large number of press tools and machines.

Workshop Tools

Readers will be familiar with the many Terry products for the workshop, which include sets of spanners, both individual and folding, for Whitworth and B.A. nuts, screwdrivers and various tools for motor and cycle servicing, also flexible shafts, and tool clips in a wide range of sizes. The sets of assorted springs which are found useful in every workshop, are made in a number of different ranges, and similar sets of spring clips are also available. Tool racks for the workshop, to hold all sizes and types of tools, can be made by fixing a row of these clips to a strip of metal or wood, and they can also be used to hold tools in place in repair kits, chests or cabinets. The special requirements of model engineers have been given careful consideration in planning future lines of production, and Mr. Norman Terry, who is himself a keen model engineer, and president of the Redditch and District Society of Model Engineers, has brought his specialised experience to bear on model engineering problems. The well-known device of using springs to prevent flattening or kinking of tubes while bending them has been adapted so as to be suitable for small diameter tubes, and Mr. Terry has demonstrated its usefulness in the construction of his *Juliet* locomotive.



A barrel-shaped spring being formed

To those who wish to obtain special information on the design of springs for all purposes, Terry's handbook on "Spring Design and Calculations" can be confidently recommended. The reliability of the information in it is obviously unimpeachable. It should, however, be noted that spring design involves some fairly complicated mathematics, as so many factors have to be taken into consideration that problems cannot be solved by rule-of-thumb methods.

TRUE CENTRING IN THE LATHE

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not to file down quite as much as this, but to make the final reduction by grinding after the tool has been hardened and tempered.

At (*C*) in the drawing it is shown that the tool is slightly off-set from the centre-line of the job, with the tip pointing slightly forward to ensure clearance. The top-slide of the lathe is, of course, set over to an angle of 30 deg., and it is essential that the tool be at correct centre height. This type of tool is extremely frail, but is sufficiently strong for the light, "dusting" cut required.

It will be understood that the tool is not used as a form-tool, but that a light cut is taken along the wall of the centre hole, as in ordinary, single-point boring.

The job is now reversed in the lathe, clocked up as before, and the other plug centred in like manner.

Provided that the work is set in the chuck, and in the fixed steady, with reasonable accuracy, and that the steady is as close as possible to the end of the job, a centre hole which is concentric with the outside of the work will be obtained. In practice, it is not necessary to line up the job in the lathe to the very last half-thou., because if the steady jaws are well lubricated, and set to grip the work fairly tightly, the end of the job will be constrained to run truly for the short time required. This does not mean, however, that you may employ careless setting; every care should be taken to ensure that the work is running as truly as is reasonably possible.

Apart from the usefulness of this method for centring round bars, it may also be employed to rectify that most annoying of faults—a centre hole which has been drilled out of centre.

QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Astronomical Telescope Bearings

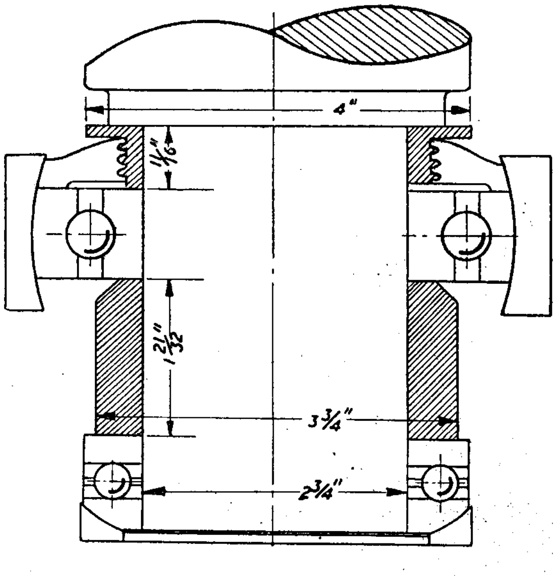
The drawing reproduced herewith shows the South bearing of a telescope I have in construction. Please advise me of the names of the parts shown cross-hatched, and how they may be produced without having to make patterns and castings.

The work will have to be carried out on a Myford ML.7 lathe.

L.M.D. (Liverpool, 14).

The parts shown cross-hatched would appear to serve the primary function of distance bushes to locate and take the bearing on the inner race of the self-aligning ball-bearing. The upper flanged bush, however, appears also to form part of a closure, or a sealing device, to keep water or other foreign matter out of the bearing housing.

It is quite possible to make both these bushes out of solid metal, and the particular metal would appear to be more or less immaterial, so long as it is strong enough to take the thrust.



We would suggest that aluminium alloy would be suitable. It would, however, be extremely difficult to obtain either solid or hollow bar to cover the dimensions given, and we suggest that it would save both trouble and expense to make simple patterns with due machining allowance, and get the items cast. The work involved would be well within the machining capabilities of the ML.7 lathe.

Electric Estate Carriage

I propose to construct a very light single-seated electric estate carriage having the chassis in light alloy tube and a covering of thin ply or aluminium, total weight not to exceed 300 lb., including the passenger. The performance required is a duration of not more than one hour's continuous running at a maximum speed of 30 m.p.h. on good roads.

The wheels will be 20 in. diameter cycle pattern, with independent springing on all four, and final drive by roller chain to a free-wheel on each rear hub, so dispensing with a differential.

Will it be practicable to use two car or lorry starter motors to propel this vehicle? What h.p. could safely be extracted from such motors running continuously for one hour, and what current would be required to produce it?

What is a suitable ampere-hour capacity for the battery, and what is the maximum continuous discharge which could be taken from an ordinary car battery without damage?

E.J.W. (Stratford-on-Avon).

It is quite possible that a large car starter motor could be used to propel this vehicle, but as motors of this type are intended for running very short periods, trouble may be experienced through heating of the motors if they are run continuously. It is also very probable that the electrical efficiency of such motors might not be very high, but they may do the work you require of them, and we are of the opinion that the matter could only be settled by experiment.

We consider that a battery for a vehicle of this type should be of not less than 200 amp-hour capacity, as the discharge rate may have to be fairly high, especially when starting or climbing.

Generally speaking, it is not safe to discharge the normal type of lead-acid car battery continuously at a rate exceeding 1/10 of its amp-hour capacity.

"Seal" 15 c.c. Engine

Can you inform me whether I can purchase a "Seal" 15 c.c. 4-stroke petrol engine ready-made, as I have no facilities for machining the castings myself?

R.J.D. (South Hackney).

We regret that we cannot advise you where to obtain a "Seal" 15 c.c. petrol engine ready-made. You will no doubt appreciate the fact that owing to the very considerable amount of work on such an engine, it would be an expensive proposition, and up to the present it has been impossible to get anyone to undertake the manufacture of an engine of this type.

It is, however, possible that by advertising in our small ads. columns, you may find someone who is prepared to machine and fit a set of castings for this engine.

Enlarger Focussing Device

Please advise me where I can obtain a focussing device for a 35 mm. enlarger, or alternatively, could I get one made from my own drawings?

R.T.E. (Smethwick 41).

We are not certain whether by "focussing device" you mean the actual focussing motion on the enlarger itself, or a device for facilitating sharp focussing of the image on the enlarger easel.

If you will give us more specific information on this point we may be able to advise you further on the matter. Helical focussing mounts for enlargers can be obtained from Brunnings (Holborn) Ltd., 133-135 High Holborn, London, W.C.1.